# Eyewitnesses and the effect of memory conformity and self-confidence on eyewitnesses

EYEWITNESS MEMORY CONFORMITY AND SELF-CONFIDENCE IN REVERSE CORRELATION AND PHOTOGRAPH LINE-UP

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# Abstract

Eyewitnesses are often uses in a Police investigation, the Police values their statement as important. But what if eyewitnesses are not as reliable as we think. Especially after they discussed the crime and memory conformity occurs. Self-confidence of the eyewitness play's an important role when memory conformity occurs. To test all this we used a new technique called Reverse Correlation. This method was to see if this can be used to replicate the face of the assailant. In this study we found a main effect for memory conformity for the resemblance of the suspect and the aggressiveness level. No main effect for self-confidence. Furthermore we found an interaction for memory conformity and self-confidence for the resemblance of the suspect and the aggressiveness level. Concluded memory conformity occurs when eyewitness discuss the crime. But when self-confidence is high eyewitness will conform less than when self-confidence is low. For RC we found that it is a great method to sort of see in the participants mind trough this technique. If it could be used for real eyewitness is still to question.

# Samenvatting

Ooggetuigen worden vaak gebruikt in een politie onderzoek en de politie hecht veel waarde aan hun verklaringen. Wat nu als ooggetuigen nou niet zo betrouwbaar zijn als we denken. Vooral nadat ze de criminele gebeurtenis hebben besproken kan er geheugen conformiteit optreden. Ook zelfvertrouwen van ooggetuigen speelt een belangrijke rol vooral bij geheugen conformiteit. Om dit te testen wordt er in dit onderzoek gebruik gemaakt van een nieuwe methode genaamd Reverse Correlation. Deze methode wordt mede gebruikt om uit te proberen of het gebruikt kan worden in het repliceren van het gezicht van de dader. In deze studie vonden we een hoofd effect voor geheugen conformiteit op de vergelijk van de verdachte en de agressiviteit graad, geen hoofd effect voor zelfvertrouwen en een interactie effect van geheugen conformiteit en zelfvertrouwen op de vergelijk van de verdachte en de agressiviteit graad. Concluderend geheugen conformiteit treedt op wanneer ooggetuigen de gebeurtenis met elkaar bespreken. Daarnaast heeft de mate van zelfvertrouwen een belangrijke rol. Bij hoge zelfvertrouwen conformeren ooggetuigen minder dan wanneer er lage zelfvertrouwen wordt waargenomen. RC is een methode voor het observeren wat er gebeurd in het hoofd van de participant. Of het ook gebruikt kan worden voor echte ooggetuigen blijft nog steeds de vraag.

# Eyewitnesses and the effect of memory conformity and self-confidence

After serving more than 25 years in Texas prisons for a crime he did not commit, Johnnie Lindsey was proven innocent through DNA testing and was freed in 2008. The case was that of a 27-year-old woman who was attacked and raped by a shirtless African-American man. In two photograph line-ups shown to the victim within days of the attack, she did not identify anyone. The case remained unsolved for a year. After that year the detectives mailed her a new photograph line-up. From this line-up of six men, she identified Lindsey as the attacker (Innocent-project, 2009)

The purpose of the law is to protect the innocent and detain the guilty. Nevertheless, sometimes mistakes are made and once in a while an innocent person goes to jail. This is one of many stories that can be found all over the world. What goes wrong and why? This study will further explore the part of the eyewitness in a police investigation. We will particularly focus on when eyewitnesses discuss the crime and will study a new technique to use for eyewitnesses to recreate the suspects face after a crime.

Eyewitness reports are one of the most important sources of evidence in crime scene investigation (Werner, Kuhnel, & Markowitsch, 2013). For example; they may be required to give a description of the person who committed a robbery or an assault on another person. As the eyewitness can identify perpetrators and describe details of the crime scene (McLeod, 2009). Thus, in a police investigation and in court an eyewitness testimony is generally found to be a reliable source of information. However, research shows that eyewitness testimonies can be affected by many psychological aspects such as stress/anxiety (Clifford & Scott, 1978), the reconstruction of the memory (Bartlett & Burt, 1933), more focus on the ‘gun’ than the assailant (Loftus, Loftus, & Messo, 1987) and leading questions (Loftus & Palmer, 1974).

Even though they are all important this present study will be focusing on the memory of the eyewitness.

How does memory play a role in eyewitness testimony? Memory has three stages; encoding, storage and retrieval. Retrieval can be done in two different ways: by recall or recognition. Recall is without any presented clues and therefore more difficult than recognition which is based on presented signs or evidence (Srull, Lichtenstein, & Rothbart, 1985). McLeod (2009) argued that many people still believe that our memory works as a videotape. Storing information as a recording, one you can play back every time you want in an unaltered state. However, memory does not work in this way. It is a characteristic of human memory that we do not store information exactly as it is presented to us. Rather, people store information in a way that makes the most sense to them. That is why memory is crucial to understand for the assessment of reliability of eyewitness testimonies.

When a crime is committed and there are two or more eyewitnesses, it is possible that they discuss the crime before the Police have the chance to interview them. It is possible that when eyewitnesses discuss the crime, they could replace parts of their own memory with the part of the memory of the other (Goodwin, Kukucka, & Hawks, 2013; Oeberst & Seidemann, 2014; Wright, Memon, Skagerberg, & Gabbert, 2009; Wright & Villalba, 2012). For example, when a car accident occurs and there were two eyewitnesses who saw it, if one claimed that it was a red car and the other did not or vaguely remembered what she/he saw. They will go along with the other eyewitness, even when it is possibly wrong because of the lack of (good) memories by one eyewitness. In other words, when memory conformity (Allan & Gabbert, 2008; Gabbert, Memon, & Allan, 2003; Oeberst & Seidemann, 2014; Wright et al., 2009) occurs eyewitnesses will not have their own original memory anymore but will share the same identical memories even if it is not true. This can be a vast problem when eyewitnesses take

part in a police investigation (Baron, Vandello, & Brunsman, 1996; Gabbert, Memon, & Wright, 2007; Wright et al., 2009).

When memory conformity occurs confidence and self-confidence can play a role (Garry, French, Kinzett, & Mori, 2008). As for confidence it is perceived through perception of our own memory and that of the co-eyewitness (French, Garry, & Mori, 2011). For self-confidence it will change in line with how we judge our own memories as a result of our own expectations about our abilities (French et al., 2011). Since a lot of research is already been done on confidence and less about self-confidence we will concentrate on self-confidence and memory conformity of eyewitnesses.

It's important for a police investigation that the eyewitnesses remember the face of the assailant. Fortunately humans are good at remembering faces (Werner, Kuhnel, & Markowitsch, 2013), but if you ask someone to describe a face, it is still hard to say what kind of features the face has (Frowd, Bruce, McIntyre, & Hancock, 2007; Keenan, Resconi, Kerry, & Hamill, 2014). When reconstructing a face on composites it goes feature by feature, therefore it is hard to describe a face for a composite (Dotsch & Todorov, 2012; Frowd et al., 2007), which can also create a problem when identifying a suspect. Research shows it is not the best way to replicate a face of the offender (Wells & Hasel, 2007).

Shown by Frowd., Bruce, Smith, & Hancock (2008) and Garry et al. (2008) and Richler & Gauthier (2014) the restoring and recognition of a face is a more holistic process. Therefore, a new system called Reverse Correlation (RC) (Frowd. et al., 2008; Frowd. et al., 2005; Mangini & Biederman, 2004) is introduced for reproducing the assailant's face. In this technique, holistic based recognition of a face will be provided instead of the feature based when a composite drawing is made (Frowd. et al., 2013). RC will create out of the many trials a new "face", this is called a classification images (Dotsch & Todorov, 2012). Also this system is new in its field and is therefore not yet fully researched. For that reason this study

will concentrate on recreating the assailants face through Reverse Correlation. As a default also the original photograph line-up will be used, to see if there is a difference between that and a RC classification images. The aim of this study is: *To what extent does memory conformity and perceived self-confidence have an effect on the eyewitness when Reverse Correlation technique and a photograph line-up is constituted?*

**Reverse Correlation**

Reverse Correlation is an program used in the 1970s in the domain of auditory perception (Dotsch & Todorov, 2012). Later it was adapted for research in vision and neurophysiology. For social research, RC is a more recent approach which provides some insight into the perceptual templates and decision strategies of the participants (Dai & Micheyl, 2010b; Mangini & Biederman, 2004). In this study RC techniques work as followed: There will be a constant base face (morph) with randomly generated "noise" patterns, applied to different parts of a stimulus across many trials (more than 800) and the responses that are given by the participant on these trials (Dai & Micheyl, 2010a). Of the different "noise" patterns over the base face, which creates many variations of facial images, in this way every face looks different. The two "noise" patterns are just as photograph negatives, and for each original "noise" pattern there is a negative pattern. This means that when one pixel is dark in the original it is bright in the negative (Dotsch & Todorov, 2012). After many trials the response of the participant is calculated and their choice will create a "new" face which is revered to a classification image (Mangini & Biederman, 2004). Thus, RC will provide direct insight into the perceptual templates of the subject (Dai & Micheyl, 2010a).

By means of this technique, researchers can generate images that reflect the participants internal representation of faces, without having to guess what those

representations might look as (Dotsch & Todorov, 2012). Mangini and Biederman (2004), shown that the main contribution of RC provides an efficient and effective method to estimate what is in the subjects mind determining the response, rather than in the experimenter's mind.

RC is a technique to understand how faces can be identified (Dai & Micheyl, 2010a). We are better at recognizing faces than recognizing any other item (Werner et al., 2013). Which can be convenient after a crime for catching the assailant in a police investigation. However, there is a difference between recognizing and describing faces, when it comes to memory. Remembering a face is easy, but describing it through recall for a composite is really hard (Dotsch & Todorov, 2012; Frowd et al., 2007). There is a difference between holistic restoring and feature based reconstructing a face (Frowd et al., 2007; Keenan et al., 2014). When reconstructing a face on a composite, it goes feature by feature. So how large or small is the nose or eyes or lips. But remembering and recognizing a face, is a more holistic process. Which is done through remembering the entire face at once and not by exclusive different parts of a face. (Frowd. et al., 2008; Garry et al., 2008; Richler & Gauthier, 2014).

Since, RC is relative new for the research in social science. With a direct insight in perceptual templates and has a holistic approach of creating faces, this technique will be studied. For either to see if this technique is better than traditional methods for doing research. But foremost if it will hold up in cases of memory conformity. Furthermore to see if it will be an appropriate way to create the face of the suspect instead of a composite.

**Memory Conformity**

We explained above that memories are not stored as videotapes as many people believe. They are stored and retrieved in the way it makes sense to us (McLeod, 2009). Werner et al. (2013) found that memories are vulnerable for decay and biases and with them

many researchers found the same conclusion. Wright, Memon, Skagerberg, & Gabbert (2009) claim that memories are ambiguous or incomplete, due to the fact of incorrect restoring, simply forgetting the information, confusing of different experiences or by being influenced by others. The mind will fill in the gaps with experience we already poses or the memories of other people we have contact with. This means that our memories sometimes rely on memories of others to fill in the missing gaps. Even though they may not be in line with reality (Wright & Villalba, 2012).

Wright et al. (2009) explains that false memories can arise for a variety of reasons. Possibly false information is stored because it is embedded in the information of the other eyewitnesses. In other cases, people may explicitly encode the information and be aware of the source, but as time passes they may forget the source of the information, but not the information itself. In both of these situations, people make source-monitoring errors in which they falsely attribute the information suggested to them by the other person and that they encoded that as a part of the original event (Johnson, Hashtroudi, & Lindsay, 1993).

Wright et al. (2009) explains that there are three related processes that underlie to memory conformity; normative, informative influence and false memory. Normative influence follows the work of Asch (1955 ) which shows that when people are in social situations they are more likely to comply with the group norms to gain social acceptance. Informative influences is based on Sherif (1936) theory and occurs when people are removed from the social situation and still report that what somebody else said, because they believe the other person. False memory is studied by Loftus (1979) and shows that false memory happens when a person entirely overtakes the memory of the event from another person, even when the person did not experience the event themselves. This person is convinced to have witnessed the event suggested by someone else (Oeberst & Seidemann, 2014).

Williamson, Weber, and Robertson (2013) suggest that informative influence is most likely to occur when eyewitnesses conform. This means that an eyewitness believes the memory of a co-eyewitness is superior to their own (Wright, London, & Waechter, 2010) and trust that the co-eyewitness is correct, even when they are not (Oeberst & Seidemann, 2014). The data from Garry et al. (2008) suggest that, in 85% of the time people agreed with their partner during the discussion by incorporating their information, because they believed their partner is accurate and reliable (for similar findings see Wright et al. 2010). People are more willing to conform when they were told the results were important, say a police investigation versus a pilot study (Baron et al., 1996).

Therefore, this study will focus on the informative memory conformity process. Memory conformity has an effect on the eyewitness, after the crime has taken place. It can have an influence on every aspect in a police investigation, such as composite drawings (which in this study will be RC), but also on (photograph) line-up's. Even in real cases where eyewitnesses provide evidence, that memory conformity plays a main role. For example the case of McVeigh, in which the eyewitnesses who saw McVeigh rent the truck, used in the Oklahoma City bombing, only came to believe McVeigh had an accomplice after speaking with an confident co-eyewitnesses (Memon & Wright, 1999).

Hence, we will further investigate which effect informative memory conformity has on RC. Since, we use more practical words to describe the hypotheses, the next concepts will be defined. Influence will be a shorter version of memory conformity. The RC images will be measured on two different levels, (1) the resemblance of the suspect and the (2) level of aggressiveness. (1) The resemblance of the suspect will tell how much the RC images matches with the original photograph and will show how much the RC images has changed compared to the original. (2) The level of aggressiveness, this facial expression is used to see how much the content of the conversation is altered through memory conformity. We will rate

the RC images on how much effect the content of the influence has. These two different levels are chosen because they each represent a different aspect of the face. One will be measuring the whole and the static representation of the face. The other will be more about the changing characteristic in the face. Furthermore, the facial expression aggressiveness fits perfectly by the context of eyewitnesses.

Consequently, what effect has memory conformity (influence) on the Reverse Correlations classification images (resemblance suspect and level of aggressiveness). As a result Hypothesis 1 is as followed: *We expect a main effect of influencing (yes/no) on the level of aggressiveness and resemblance of the suspect. The RC images will be a good resemblance of the suspect and will have a low level of aggressiveness when participants experienced no influencing versus a bad resemblance and high level of aggressiveness when influenced.*

In addition to informative memory conformity confidence has a really important role. As is shown in the real-time case, the co-eyewitness was really confident about something he did not saw and that is why the other eyewitnesses came to believe his story. For that reason confidence will be further explained.

**Confidence**

Research show that confidence plays a large roll when it comes to memory conformity (Garry et al., 2008). Confidence is perceived through perception of our own memory and that of the co-eyewitness (French et al., 2011). In this study confidence has three components accuracy, credibility and reliability. Accuracy is think of the other person more precise, credibility is think of the other more plausible and reliability is think of the other more consistent. Allan, Midjord, Martin, and Gabbert (2012) claims that people conform through perceived confidence of the memory of the other person and the perceived confidence of their own memory. After this people combine the information and make a judgement about which

memory is correct and which is incorrect. Various studies, illustrated cases were a person appears more confident than the other, at that point people are more likely to conform, then when a person does not appear confident (Allan et al., 2012; Wright et al., 2010; Wright et al., 2009). French et al. (2011) and Horry, Palmer, Sexton, and Brewer (2012), did research about self-confidence. Self-confidence will change in line with how we judge our own memories as a result of our own expectations about our abilities (French et al., 2011). Self-confidence was low when participants had less time to encode (Horry et al., 2012). French et al. (2011) demonstrated, that people make relative judgment when they are confronted with other information from participants about an event. They say that people judge their self-confidence of their memory contrary to the other participant. They have proven that participants are less likely to conform to someone else that is less credible than themselves. Also Wright and Villalba (2012) indicated that even when the other person appears confident, but our self-confidence is higher, than no memory conformation will take place.

This study will further take a look at what effect self-confidence will have on Reverse Correlation classification images. In this case self-confidence will be measured as recognition. Here we will only measure self-confidence on one level namely that of the resemblance of the suspect as explained before. Therefore, the next hypothesis is about a main effect of self-confidence (recognition), on the RC classification images (resemblance suspect). As a result, hypotheses two (2) is: *We expect a main effect of self-confidence on the resemblance of the suspect. The RC images will have a better resemblance of the suspect when participants experience high self-confidence, than when a low self-confidence is experienced.*

People compare their perceived self-confidence to perceived confidence, of the other person and make a decision to conform. As a result the assumption is that a participant will make a “decision” to informative conform, because they perceived the other as more confident in their memory even when this memory may in fact be incorrect. Nevertheless, if

the participant has more self-confidence of their memory, they will not conform. Thus, the participant will conform when their perception of self-confidence is low. They will not conform when they perceive their self-confidence as high.

These two concepts (memory conformity and self-confidence) will be combined. The next hypotheses will be about the interaction between memory conformity (influence) and self-confidence (recognition) on the RC classification image. This will also again will be measured on two different levels: (1) The resemblance of the suspect and (2) level of aggressiveness. As a result, for resemblance of the suspect the hypotheses 3a is: *There will be an interaction effect between influence (yes versus no) and self-confidence (high versus low) on the resemblance of the suspect. When confidence is high there will be no difference in the RC images for the resemblance of the suspect. If self-confidence is low there will be a difference in RC images. When there is no influence suspect resemblance will be higher than when there is influence.* For aggressiveness level the hypotheses 3b is: *There will be an interaction effect between influence (yes versus no) and self-confidence (high versus low) on the level of aggressiveness. When confidence is high there will be no difference in the RC images for the level of aggressiveness level. If self-confidence is low there will be a difference in RC images. When there is influence the level of aggressiveness will be higher than when there is no influence.*

Besides RC a photograph line-up will be part of this study as well. That test can indicate, if there will be a difference between RC and a photograph line-up. For that reason, the two concepts, memory conformity (influence) and self-confidence will be studied in a line-up. Whereas we will look at the performance of the participant on the line-up. As a result, hypothesis four (4) will be: *There will be an interaction effect between influence (yes/no) and self-confidence (high/low) on the performance of the line-up. When confidence is high the suspect will be chosen out of the line-up. If self-confidence is low there will be a difference*

*between the chosen suspect in the line-up. When there is influence the suspect will not be chosen and when there is no influence the suspect will be chosen.*

# Method

This study required two different but combined experiments. In part one, participants were asked to reproduce the face of the suspect in RC technique and by choosing the suspect from a photograph line-up. Participants were randomly influenced (yes/no) through a chat-conversation and the participants subsequently received face recognition (high/low), which was administered through a bogus test.

In part two, participants will rate the images through two different tasks and one task will be a line-up. The three tasks are: the similarity task (rating), the matching task (line-up) (Frowd. et al., 2005) and the aggressiveness task (rating). The participants who did the first experiment did not conduct the second.

## Part 1

### Participants

A total of thirty-four (34) participants contributed to this study. Of the 34 half was male (17) and half was female (17). We applied a snowball sampling method, which means that family and friends of the researcher participated in this study. Participants were between 20 and 58. Participants differed in education status from high school education to university education but most participants obtained MBO (29.4%) or HBO (44.1%) education. Of the 34 participants, 25 a fulltime job, others had either a part-time job or went to school.

## Design

This study has a 2 x 2 design and 34 trials with both RC and photograph line-up. Participants could either have an influencing chat-conversation or a no-influencing chat-conversation and have a high or low self-confidence. The depending variables are: (1) The resemblance of the suspect, (2) the level of aggressiveness of the RC images and (3) performance of the photograph line-up.

The mock-up chat-conversation was programmed in Qualtrics before the experiment took place and had two different variations, one was influenced by saying that the face they saw was aggressive and angry, and the other was not influenced and only spoke about the video they have seen. All the participants had a chat-conversation to avoid verbal overshadowing. Confidence was altered by a bogus test and half of the participants got a high face recognition outcome and half of them got a low face recognition outcome.

## Materials

The experiment worked with two computer programs, a “Qualtrics” questionnaire program were most of the experiment was programmed in. As well as, an “Inquisite millisecond” program, were the Reverse Correlation task was programmed and played on.

The suspect photograph was chosen out of the eight other photographs, with the most neutral face, provided by the Radboud Face Database (Langner et al., 2010).

The video of a supermarket robbery which lasts 1.25 minutes was selected out a lot of videos. For the reason that for one, it had to be something people could relate to, a supermarket robbery could happen to anybody. Second, the perpetrators in the video needed to have their faces covert so the participants would not get confused with the suspect shown at

the start of the experiment. Third, the video needed to come from a reliable source, this video came from a well know detective TV-program in the Netherlands.

The face recognition (self-confidence) was manipulated through a bogus test. This test was derivate from the 'Face in the Crowd Task' (Hansen & Hansen, 1988) to fit this experiment. The photographs and the layout are applied but the feedback of right and wrong was excluded. "Qualtrics" was programmed to randomly tell the participant if they are good at recognizing faces or bad at recognizing faces. It did not matter if the participants answered correctly or not.

The mock-up chat-conversation on the computer, was created especially for this study. One was made to influence the participant and the other was made not to influence, to avoid verbal overshadowing. The one that was influenced, will state that the video's suspect contains facial expressions of aggressive nature, to attain a result were the participants are manipulated into thinking that the face of the suspect had become more aggressive. But in fact the suspects photograph had a natural face expression. The facial expression was implemented for the reason that it perfectly fits, with the context of the experiment. Besides the holistic way of incorrect information about the suspects (aggressiveness), also the features have been addressed in the chat-conversation. As a result both feature and holistic way of recognizing a face was addressed. An example of the influencing chat-conversation: "By the way he looked, with his tiny squeezed mouth, he gives me the chills. That is why he looked very dangerous and aggressive. I think he can rob again very soon. Don't you think?". All the information that was given about the face of the suspect through the influenced chat-conversation, was incorrect. Therefore, the information did not fit with the suspects face and facial expression. In the no-influencing chat-conversation, the information that was given, was about the robbery, here no information was given about the face. An example of the no-influencing chat-conversation: "They were all covered in black even their faces, this way you could not

see who they were. It looks very scary to me. What would you have done, if you were in the supermarket at that moment?".

For the photograph line-up, eight preselected Caucasian standardized up front face photographs are presented, which are provided by the Radboud Face Database (Langner et al., 2010). All suspects are also rated individually, on a Likert scale (1= totally not, to 7= totally) to see how representable this line-up is.

The same faces were the bases of the morph created for RC. In RC this morph face has a noise pattern over their face, therefore it display the face differently every time (Dotsch & Todorov, 2012), how the noise pattern works was already explained above. Under the two morph faces there will be a Likert scale (1= obvious or 2= probably or 3= probably or 4= obvious).

In the questionnaire the demographic questions are asked plus four important questions about the chat and face recognitions are asked to check if the manipulations have worked. Question for face recognition; "How good are you in recognizing faces?" Questions for chat-conversation; "How well did the chat-conversation with the other participant go?" "Did you received any information about the robbery?" "Did you receive any information about the face of the suspect?"

**Procedure**

Participants were invited to the laboratory, were they were placed individually behind a laptop in a study room. First, participants were explained what the experiment was about. Then, they signed a consent form and afterwards the targeted suspect's photograph was presented for 10 seconds. After that, they could continue on the computer, they will first watch a short movie about a violent robbery in a supermarket. Following, they are given a

bogus face recognition test, which contained an overall picture of a crowd with the instructions to remember the faces in the crowd. After 20 seconds 10 individual faces were presented after each other and the participants were asked if this individual was in the crowd. After that, they will be told that they randomly scored either really good or really bad. Following that, participants randomly either got an influencing chat-conversation of no influencing chat-conversation. To make the chat look real, participants had to choose a picture that was displayed on the screen and type in their chat name. To prevent misinterpretation, participants were explained that the rest of the experiment was about the suspect in the photograph they had seen from the beginning.

Then, all the participants took part in the RC task and the photograph line-up, both tasks were randomly selected to be first and second. RC worked as followed, participants first got an introduction about how RC worked, and then they got a try-out of twenty sets of morph faces with noise patterns. After that they made the real test with 780 sets of morphs and had three breaks every 25%, 50% and 75%. In these breaks they were asked to do a puzzle or some office stretching. The line-up task was as followed, first participants got to see every photograph individually and had to rate, on a scale of one to seven, how much they looked such as the suspect. After that they will be shown eight photographs at the same time. Participants were asked to choose one of the photographs as the suspects face. At the end participants are asked to fill in a short questionnaire.

## Part 2

### Participants

A total of ninety-eight (98) persons took part in this study. Of those participant 20 were male and 76 were female, of two participants we do not know their gender. We applied a

snowball sampling method, which means that the family and friends of the researcher participated in this study. Participants had the age between 17 and 61. Participants differed in education status from high school education to university education, but most participants obtained MBO (37.8%) or HBO (30.6%) education. Of the 98 participants, 27 had a fulltime job, 12 part-time job and 46 went to school others either did not work or were looking for work.

**Materials**

There were RC images for the four interaction conditions of recognition (high/low), influencing (yes/no) plus images for every variable alone and the overall image. These images have been created through the individual images made by the 34 participants. To evaluate those images we had to use three different task; similarity task, a matching task (Frowd. et al., 2005) and aggressiveness task was to see how aggressive the images looks alike. Frowd. et al. (2005) and Wells and Hasel (2007) done multiple studies regarding the similarity and matching tasks in facial composite systems. The Qualtrics questionnaire was used to achieve this part of the experiment.

Of the five matching tasks one was presented randomly to the participant. The RC images was shown with the question; “Which of the faces below looks like the images above”. For the photograph line-up, eight preselected Caucasian standardized up front face photographs are present which were provided by the Radboud Face Database (Langner et al., 2010). Participants needed to choose one. For the similarity task and the aggressive task all the questions were presented. The similarity task had nine questions and the aggressive task had six. The nine questions presented an images for the four conditions plus an image for every variable alone (influence and recognition) and an overall images. The images and the

suspect photograph and the participant were asked to rate the images on how much it looks similar the suspect photograph on a Likert-scale ("To what extend looks the right photograph like the left images", "1= entirely not, 7 = entirely true"). The six images of the aggressive task presented the images of the four conditions plus the variable influencing. The images was shown alone with the question; "To what extend do you think this face looks aggressive?" on a Likert-scale ("1= entirely not, 7= entirely true").

**Procedure**

Through a link to Qualtrics participants could login on the website and do the questionnaire at home. They are told that there is a new technique in identifying perpetrators and that we needed their help to get an overall idea if it works. First, participants were asked to sign an agreement. Then, the participants are randomly assigned to one of the five matching tasks, in which they will decide which of the eight photographs shown looks most like the composite images. Second, they performed the similarity-rating task, which means that the participants will be asked to give a rating of how good the image looked similar the suspect photograph. The last task was the ranking of how aggressive the images looks. Finally, participants were asked to fill in a short demographic questionnaire. No feedback was given regarding the accuracy of the response.

## Results

This study was designed to discover what effect memory conformity and self-confidence has on eyewitnesses. The independent variables are influence (memory conformity) (yes/no) and recognition (self-confidence) (high/low) and the dependent variables

are (1) resemblance of the suspect, (2) aggressive level and (3) performance on the photographic line-up. We will explore a main effect as well as an interaction effect. Unfortunately, this study had unequal response in the conditions. Therefore, for every effect there are different RC images and subsequently these effects will be tested in different statistical tests.

**Manipulation Check**

To check whether our manipulation has been accomplished, we conducted two different ANOVA's: one for the independent variable of influence and one for recognition, with a dependent variable that came from a question in the questionnaire.

First we tested the manipulation of self-confidence. The main question was "How good are you at recognizing faces?" On a 5 point Likert-scale were 5= very good, 1= very bad. We found that the manipulation has been realized ($F(1/30) = 22.703$, $p < .001$). Therefore there was a difference between if participants received high face recognition ($M = 3.87$, $SD = .342$) and if participants received low face recognition ($M = 2.39$, $SD = 1.195$). For influence we found no significant difference which is expected ($F(1/30) = .334$, $p = .568$) and we also, as expected, found no significant difference for the interaction ($F(1/30) = .458$, $p = .504$), which indicates that self-confidence is manipulated.

Second, we tested the manipulation of influence. The main question was "Did you receive any information about the face of the suspect?" Also on a 5 point Likert-scale were 5= very much, 1= very little, we found that the manipulation did not work as expected ($F(1/30) = .186$, $p = 670$). There was no significant difference between influence ($M = 2.56$, $SD =. 629$) and no-influence ($M = 2.67$, $SD = 1.24$), and there was also no significant difference for face

recognition ($F(1/30) = .594$, $p = .447$). The same applies for the interaction were there was no significant difference ($F(1/30) =. 011$, $p = .919$).

**Main Effect of Influence**

To test our first hypothesis which maintained that there is a main effect of influence, two separate paired t-tests were conducted, for both dependent variables (1) the resemblance of the suspect and (2) the aggressiveness level of the RC image. In both variables the same two RC images were used (see below), one with merely influence and one with no-influence. With the question, for (1) resemblance of the suspect: "How much does the image look like the photograph of the suspect?" and (2) aggressiveness level: "How aggressive does this image look?" Both variables were rated on a 7 point Likert-scale (1= totally not; 7 = totally true).

No-influence

Influence

**Resemblance of the suspect (1).** The first dependent variable was to compare the RC images with the suspect. A paired-samples t-test was conducted to compare the resemblance of the RC images with the suspect when participants either got influenced or no influence. We found a marginal significant difference in the scores for influence and no-influence ($t(97) = 1.84$, $p = 0.69$). These results suggest that influence (yes/no) has an effect on the RC images.

But the means of the variables resulting in the wrong way, for influence (*M* = 4.88, *SD* = 1.48) and no-influence (*M* = 4.54, *SD* = 1.51). This unforeseen result suggested that when the influence increases the accuracy from the RC images also increases and when there is no-influence the images decreases. However, it should be the other way around.

**Aggressiveness level (2).** The second dependent variable compares the two RC images on the level of aggressiveness. Also a paired-samples t-test was conducted to compare the aggressive level of both RC when participants either got influenced or no-influenced. There was a significant difference in the scores for influence and no-influence (t (97) =4.86, *p* = <.001). These results suggest that influence (yes/no) has an effect on the aggressiveness level of the RC images. As for these results the means are going in the direction as predicted, for influence (*M* = 3.19, *SD* = 1.41) and no-influence (*M* = 2.47, *SD* = 1.36). According to these results people will influence each other if they exchange information on the face of the suspect. Consequently, there is a main effect of influence on RC classification images.

**Main Effect of Self-confidence**

To test our second hypothesis, which contained a main effect of self-confidence, a paired t-test was conducted, for the dependent variable the resemblance of the suspect. Unfortunately, no ratings were done for aggressiveness level and therefore it is not possible to report them. For this variable also two RC images were used (see below), one with high self-confidence and one with low self-confidence. Both images were rated with the question: "How much does the image look like the photograph of the suspect?", again on a 7 point Likert-scale (1= totally not; 7 = totally true).


Low self-confidence


High self-confidence

A paired-samples t-test was conducted to compare the resemblance of the RC images with the suspect when participants either got high recognition or low recognition. There was no significant difference in the scores for high recognition and low recognition (t (97) = 0.86, $p$ = 0.39). Clearly our results suggest that the level of self-confidence does not have an effect on the RC images. This means that self-confidence did not have a main effect on RC images.

**Interaction Effect RC**

To test hypothesis three, an interaction of influence (yes/no) and self-confidence (high/low). Two repeated measures (RM) ANOVA have been conducted, for both dependent variables (1) - the resemblance of the suspect and (2) the aggressiveness level of the RC image. In both variables the same four RC images were used (see below), and each of them displayed the interaction on different levels. All the images were rated on a 7 point Likert-scale (1= totally not; 7 = totally true). With the question for (1) the resemblance of the suspect: “How much do the images looks like the photograph of the suspect?” and (2) the aggressiveness level: “How aggressive do these images look?”


Low self-confidence
Influence


High self-confidence
Influence


Low self-confidence
No-influence


High self-confidence
No-influence

**Resemblance suspect.** The first RM ANOVA, compared the resemblance of the four RC images with the original photograph of the suspect. It shows that there was a significant interaction effect of influence and recognition $F(1, 97) = 17.99$, $p = <.001$, partial $\eta^2 = .156$. These results suggest that influence and recognition have an interaction effect on the resemblance of the RC images. The effect size reveals that the effect is quite large. However, here we found an unforeseen result, that one mean does not result in the way predicted. As expected there was no significant main effect of influence ($F(1, 97) = .51$, $p = .45$) and recognition ($F(1, 97) = .85$, $p = .36$) on the resemblance of the suspect.

In addition to an ANOVA, we also conducted a simple effect analysis of recognition on influence. Our hypothesis predicts that when a participant has high recognition (self-confidence) it will not make a difference if one receives influence or no-influence. Nevertheless, when a participant has low recognition (self-confidence) it will make a difference if one receives influence or no-influence. We found that for low recognition influence has a significant effect ($p = .023$, $\eta 2 = .052$): recognition was worse in the influence (M = 4.13, SD = 1.62) than in the no-influence condition (M = 4.59, SD = 1.49). As for high recognition we also found a significant effect ($p = < .001$, $\eta 2 = .132$) in the opposite direction: recognition was better for the influence (M = 4.61, SD = 1.54) than in the no-influence condition (M = 3.92, SD = 1.72). Consequently, if we look at the effect size we see that the

effect for high recognition is much higher than that of low recognition. Still if we take a look at the one mean for high recognition we see that is still higher than the means of the low recognition. Therefore high recognition is important when one receives influence or no-influence.

**Aggressiveness level.** The second RM ANOVA, will compare the aggressiveness level of the four RC images. It shows that there was a significant interaction effect of influence and recognition $F(1, 97) = 4.96$, $p = .028$, partial $\eta^2 = .049$. These results suggest that the interaction of influence and recognition have an effect on the aggressiveness level of the RC images. However, if we take a look at the effect size it shows that this is quite small. Dissimilar, to the other dependent variable the means resulting in the way as predicted. We also found a main effect for influence ($F(1, 97) = 45.75$, $p = <.001$, partial $\eta^2 = .132$) and a main effect for recognition ($F(1, 97) = 13.43$, $p = <.001$, partial $\eta^2 = .122$). The significant level, as well as the effect size level of the main effects are higher than the interaction which means that there is not merely an interaction but also a main effect.

In addition to the ANOVA, a simple effect analysis has also been conducted, of recognition with influence. Our hypothesis predicts that when a participant has high recognition (self-confidence) it will not make a difference if one receives influence or no-influence. Nevertheless, when a participant has low recognition (self-confidence) it will make a difference if one receives influence or no-influence. We found similar effects, for low recognition the effect had a significant effect ($p = .001$, $\eta^2 = .110$): recognition was worse in the influence (M = 3.19, SD = 1.39) than in the no-influence condition (M = 2.52, SD = 1.38). As for high recognition we also found a significant ($p = < .001$, $\eta^2 = .293$) in the same direction: recognition was worse for the influence (M = 3.69, SD = 1.42) than in the no-influence condition (M = 3.47, SD = 1.47). Consequently, if we look at the effect size we see that the effect for high recognition is much higher than that of low recognition. Still if we take

a look at the means for high recognition we see that this is still higher than the means of the low recognition. Therefore high recognition is important when one receives influence or no-influence.

**Interaction Effect Photograph Line-up**

To test the last and fourth hypotheses of an interaction of influence (yes/no) and recognition (high/low) on the performance of the photograph line-up, we conducted a Chi-square. There was no significant interaction effect of influence and recognition on the performance of the photograph line-up $X^2$ (6, N = 34) = 8.13 p = .229 which means that the interaction effect of influence and recognition did not have an impact on the photograph line-up that was presented.

This result could possibly originate from an improper photographic line-up. The faces of the 'suspects' that have been used to form a photograph line-up were not similar looking and the suspects do all need to look similar to avoid a look-a-like is selected out of the line-up. To show that this line-up was indeed improper an ANOVA was conducted. As assumed this was not significant $F(63,107) = .779$, $p = .859$. As shown in table 1 the means that participants rated to the seven 'suspects' were not as high as the suspect on a scale of 1 to 10 (were 10 = looks defiantly such as the suspect, 1 = does such as nothing at all such as the suspect).

Table 1: *Means and SD for photograph line-up*

| Suspect | M | SD |
|---|---|---|
| 1 | 2.06 | 2.20 |
| 2 | 1.15 | 1.37 |
| 3 | 4.71 | 2.81 |
| 4 | 3.09 | 2.49 |
| 5 | 3.59 | 2.64 |
| Real 'suspect' | 7.41 | 2.60 |
| 7 | 1.74 | 2.09 |
| 8 | 1.50 | 1.78 |

## Discussion

Memory conformity among eyewitnesses does occur and when it does it becomes a big problem for the police investigation (Werner et al., 2013). In the worst-case scenario it can lead to the arrest of a suspect that is actually innocent. In this study we found evidence for memory conformity. When eyewitnesses discuss the crime memory conformity occurs. These findings are also supported by Wright and Villalba (2012) and Wright et al. (2009). If eyewitnesses talk they are not as reliable as the police might think. Moreover we found an interaction of memory conformity and self-confidence. This means that when memory conformity occurs the level of self-confidence plays a role (Wright & Villalba, 2012), and how much they will conform is dictated by how much self-confidence the eyewitness has. This study demonstrates that people with higher self-confidence were less likely to conform than people with low self-confidence. This means that when one is really confident in their memory, memory conformity is less likely to occur than when someone is not confident in

their memory. We can conclude that if someone is really confident in his or her memory we do not have to worry as much about memory conformity. However, when someone is not confident about his or her own memory we can assume memory conformity took place.

We merely found these results in the dependent variable of the aggressiveness level of the RC images and the means were not that far apart. Nevertheless, the means from the high self-confidence were higher than the low self-confidence condition. In the resemblance of the suspect we only found one mean of high self-confidence higher than the low self-confidence means. But this can be the effect of having fewer participants in this condition (read more below). However, these findings still are supported by Williamson et al. (2013) that people are more likely to conform to those whom they perceive to have superior memories than themselves. In expansion of their research high self-confidence can perhaps help to reduce memory conformity according to the results of this research. Allan et al. (2012) concluded that the memory of one's self and the memory of the other act in concert. This occurrence materializes the strategic ability to maintain a stable and reasonably accurate memory. The findings of Williamson et al. (2013) do say the same. But they also say that by comparing our own memories with the memories of others, we seek to maximize the change of having the correct memory. This only happens if we choose the information from the source that is perceived most accurate.

Interestingly, due to the unequal response in the first study we had to create different RC images for different tests, what led us to different effects. For solely memory conformity a main effect of memory conformity was found. Thus, if we look at conformity this has as expected a dominant effect. When we did the same for self-confidence there was no effect. Subsequently, self-confidence has no main effect.

However, when the interaction was tested different results occurred. For the resemblance of the suspect we found an interaction effect, but no main effects. Thus, the

interaction has definitely more impact. Therefore, it is possible that when it comes to recognize a face the interaction is more important. Then self-confidence can help reduce memory conformity. However, for the aggressiveness level, a main effect of self-confidence, a main effect of memory conformity and an interaction effect was found. The main effects of memory conformity and self-confidence were higher than the interaction. Consequently, memory conformity and self-confidence separately have more impact on the content of the conversation (aggressiveness). Which means that for the content of the information given through conversation, memory conformity is harder to reduce by high self-confidence. Then when it comes to recognizing a face which the interaction was significant. This insight is new and will lend itself very well to further research.

In this study we also found that memory conformity takes place on two different levels. That is on the (1) identity of the (whole) face (resemblance of the suspect) and the (2) facial expression (aggressiveness level). The aggressiveness level (facial expression) had a greater significance effect than the resemblance of the suspect (identity of the face), which means that there are different process when it comes to facial expression or the identity of the face. This finding supports Haxby, Hoffman, and Gobbini (2000) who proposed that facial expressions are changeable aspects. As for the identity of the face this will not have changeable aspects. In expansion of their research not only when people recognize faces they use different processes, but also when memory conformity takes place this occurs. It is important when it comes to memory conformity and recognizing a face that the changeable or facial expression is more dominant than the identity of the face, which can be really important when it comes to making a composite for further investigation and re-recognizing the face of the assailant.

Aimed at RC we wanted to discover multiple effects, first of all, if RC would hold up in the case of memory conformity. This technique also shows that it is not untouchable for memory conformity.

Second, we wanted to test if this technique would be better than traditional methods. In the study of Dotsch and Todorov (2012) and Mangini and Biederman (2004) they demonstrates that RC can be used as a technique to observe people. This study we found that it was even better than the traditional method to observe people. The traditional method was using a photograph line-up, which did not perform as expected. RC gives you an insight into the perceptual templates of the participant is without having to guess what this is. This study shows that the influence was passed on the RC images. It is even possible to see which of the features of the face were influenced. Those same features are changes in the RC images. For example, in the influenced chat-conversation the mouth and the eyes of the suspect where described to be more aggressive. When we look closer at the RC images with influence we see that the mouth is definitely more downwards curved than the one that did not have influence. For the eyes was told they were more narrow and in the influenced RC images the eyes were slightly narrower. It is possible to see exactly what has been changes in the mind of the participant through the RC images. This new form of observing people can be really helpful for studying what goes on in the mind of the participant. But, the only down point of this method is that a participant needs to repeat the trials more than 800 times, which on average takes up to an 1 hour to complete. What around an hour and a half takes to complete. It will take a lot of concentration and patience of the participant to complete the task.

Finally, we wanted to know if RC is a right technique to recreate the face of the suspect. As far as this study can say something about that is when around 30 eyewitnesses will recreated the suspect through this technique, then combine all of those RC images together there is a possible change that it will resemble the suspect. However, in this study,

the photograph of the suspect was shown just before the experiment has started for 10 seconds, under non stressful conditions. In the case of the eyewitnesses these conditions will possibly never be met plus it is unlikely there will 30 eyewitnesses at a crime. Therefore, it is hard to say whether this technique is useful.

**Limitations**

We encountered some limitations in this study. The first is that our manipulation of the chat-conversation did not work as expected. The results show that the manipulation of influence did not work. However, in this study we still found significant effects even for influence, which means that even when tests say there was no manipulation in our second study we found evidence that there was still enough manipulation that it was observed in the RC images. Therefore, it is possible that the question was not correct, because the participants did not see the information that they received as information or the manipulation took place on a more unconscious level.

Secondly, for the line-up we hoped to confirm that memory conformity and self-confidence played a big role in eyewitness testimony. Unfortunately, we did not find this result. Instead we found that it had no influence at all which was very odd knowing that many studies such as Wright et al. (2009) said something different. This occurrence could have been created by an improper line-up. As shown in the results the photographs in the line-up were totally different, in a normal line-up the faces will look similar in this study but regrettably this did not happen. For further research it will be important to have similar looking faces for a photograph line-up.

At last, for the main effect of memory conformity and the resemblance of the suspect the means are not following the predicted line. This could be because the influenced RC

images resemblance the suspect better than the one without influence. The center of this problem could be that the conditions were not evenly spread in numbers so some conditions are done a couple of times more than others, which could have created the effect that we now see. The same applies for the interaction of the resemblance of the suspect, were one mean stands out. Also for the aggressiveness level this could be part of the problem as the no-influenced scored higher for aggressiveness than the influenced condition.

**Practical Implication and Future Research**

For practical implications, when the police start an investigation on the crime that has happened and know that there were multiple witnesses it is wise to know if they discussed the crime and on what degree. If the police know how much eyewitnesses discussed the crime they need to know to what extent memory conformity has occurred. Hence, that eyewitnesses are not as reliable as expected. What the police can do is listen and find out which eyewitnesses had discussed what and with whom. It is a long shot but at the end you get a more reliable investigation. Since, in this study we found that self-confidence interact with conformity, it would be helpful to gain more insight in which eyewitness has the most self-confidence. To find out which of the eyewitness are more reliable. Further research can develop a test to know how confident the eyewitness are about their story. It would be even better to know if it would be able to recreate self-confidence after a crime. This would be really helpful in a police investigation.

A possible solution can be the H-CI interview of Frowd. et al. (2008). They have done research on how to improve recognition ability for making composite. H-CI known as holistic cognitive interview mentally reinstate the context in which the face has originally seen and improves recognition. If used as part of composite construction with real witnesses and

victims, the H-CI should substantially improve the identification of criminal suspects. Subsequently, it is possible to see if this way of interviewing is armed against memory conformity and even giving the eyewitness that has a lack of self-confidence more self-confidence to regain original memories. A new research question could be “What happens with memory conformity if eyewitnesses are interviewed with H-CI?”

Another implication for future research, could be if the difference between recognizing a face and recreating a face after a discussion is that different when it comes to memory conformity and self-confidence, then future research is recommended.

Also RC needs to be further researched as a method for observing people instead of the traditional methods that are used today since RC can be a good new technique for better and efficient understanding of perceptual templates in the mind of the participant.

**Conclusion**

In conclusion, if eyewitnesses discuss the crime it is possible that memory conformity has occurred. How much and how extensive the memory conformity is depends on the self-confidence of the eyewitnesses. If the self-confidence is high they are less likely to conform, if this is low eyewitnesses will conform easier. In this study we found a difference when it comes to resemblance of the face and the content of the conversation. With the content of the conversation memory conformity and self-confidence have less influence on each other than when they are separate. With the resemblance of the face it is the other way around in that the interaction of memory conformity and self-confidence have a lot of influence and separately they have no impact.

As for RC it can be a better way to observe people than traditional methods but it requires many trails which asks a lot of the participant, but there are still question marks about using it for recreating faces of the perpetrator(s).

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**Appendix 1**

**Mock-up chat conversation influence**

1. Floortje heeft het volgende bericht gestuurd:

Hi, ik ben Floortje. Wie ben jij? Heb jij het filmpje van de overval op de Jumbo ook gezien? Heftig hé! Wat vond je ervan?

2. Floortje heeft het volgende bericht gestuurd:

Ik was er wel van onder de indruk. Mij viel vooral de machine geweren op. Best een zware overval vond ik, wat vind jij?

3. Floortje heeft het volgende bericht gestuurd:

Ok, gelukkig heeft de politie een verdachte kunnen oppakken, dit mag niet ongestraft blijven. Heb je de agressieve verdachte ook goed bekeken?

4. Floortje heeft het volgende bericht gestuurd:

Ja hé, hij kwam heel erg eng over op mij over. Dit kwam vooral door die kleine oogjes en zijn scherpe dunne wenkbrauwen. Dat maakte dat hij bij mij rillingen over de rug deed lopen. Wat vond jij van zijn ogen?

5. Floortje heeft het volgende bericht gestuurd:

Door de manier waarop hij keek en zijn kleine op elkaar geperste mondje kwam hij heel koud en berekend over. Waardoor hij een gevaarlijkere gezicht kreeg. Volgens mij kan hij zo weer een gewapend overval zou kunnen plegen. Denk je niet?

6. Floortje heeft het volgende bericht gestuurd:

Ik kreeg het idee dat hij een heel agressief karakter heeft na het zien van de video en zijn gezicht op de foto. Vind jij ook dat zijn gezicht er agressief uitzag?

7. Floortje heeft het volgende bericht gestuurd:

Ok, volgens mij is onze chat sessie afgelopen. Ik moet namelijk verder met het volgende onderdeel. Tot straks!

**Mock-up chat conversation no-influence**

1. Floortje heeft het volgende bericht gestuurd:

Hi, ik ben Floortje. Wie ben jij? Heb jij het filmpje van de overval op de Jumbo ook gezien? Heftig hé! Wat vond je ervan?

2. Floortje heeft het volgende bericht gestuurd:

Ik was er wel van onder de indruk. Mij viel vooral de machine geweren op. Best een zware overval vond ik, wat vind jij?

3. Floortje heeft het volgende bericht gestuurd:

Ze waren ook helemaal in het zwart en hun hele gezicht was bedekt, waardoor je niet kon zien wie het waren. Dat lijkt mij best eng. Wat zou jij hebben gedaan in deze situatie als je op dat moment in de supermarkt was geweest?

4. Floortje heeft het volgende bericht gestuurd:

Het is moeilijk voor te stellen wat ik zou doen in zo'n situatie. Ik denk dat ik weg zou rennen of me verstoppen, zodat ze mij niet kunnen zien. Vooral op het moment dat hij het hele rek met de hamer kapot sloeg daardoor zal ik toch wel uit de buurt blijven van de overvallers. Heb je gezien dat de overvaller het rek kapot sloeg?

5. Floortje heeft het volgende bericht gestuurd:

Erg hé. Ik vond het ook erg dat ze al direct schoten toen ze binnen kwamen. Dat wekt hevige angst op. Wat denk jij?\

6. Floortje heeft het volgende bericht gestuurd:

Ja echt he. Bah wat naar. Is er nog iets anders wat je opviel aan de overval?

7. Floortje heeft het volgende bericht gestuurd:

Ok, volgens mij is onze chat sessie afgelopen. Ik moet namelijk verder met het volgende onderdeel. Tot straks!

## Appendix 2

Male suspect