# ****Experiments 1-2: Impression Formation with Authentic Videos****

Experiments 1-2 examined if authentic video recordings wherein a target directly communicates first-hand information about themselves would lead to the formation of self-reported and automatic evaluations. Participants were directed to YouTube and asked to watch a video of the target (‘Chris’) who was purportedly said to answer five random questions about himself for members of his YouTube channel. Half of the participants encountered a positive variant of the video wherein Chris emitted three positive and two neutral statements about himself whereas the other half watched a negative variant wherein he emitted three negative and two neutral self-statements. Afterwards participants completed measures of self-reported evaluations, automatic evaluations, and a number of exploratory questions. We anticipated a main effect of video content on self-reported and automatic (IAT) evaluations, such that those exposed to the *positive variant* videos should display positive evaluations of the target and those in the *negative variant* video should display negative evaluations.

**Method**

***Participants and Design***

165 participants (92 male, *Mage* = 30.4, *SD* = 7.6) [Experiment 1] and 167 participants (91 female, *Mage* = 31.5, *SD* = 7.6) [Experiment 2] completed the study on the Prolific website (https://prolific.ac) in exchange for a monetary reward. Assignment to different video types (either videos containing positive or negative self-statements) was counterbalanced across participants in Experiments 1-2. Self-reported ratings and IAT effects were the dependent variables. Two additional method factors were also counterbalanced across participants: evaluative task order (whether participants encountered the self-report ratings or IAT first) and IAT block order. [[1]](#footnote-1)

**Stimuli**

**Conditioned stimuli** (*people*). An unknown target individual (named Chris) served as neutral stimuli during the acquisition phase (this individual was the first author who was selected on the basis of convenience). Chris appeared during the video while his images also served as one set of category stimuli during the IAT. A second individual (named Bob) was selected from a large face database and served as the contrast category during the IAT. ‘Bob’ had previously been used in our lab and shown to be evaluated neutrally during pilot testing.

**Unconditioned stimuli (***behavioral statements***)**. Eight behavioral statements were selected for use in the videos: three positive, three negative, and two neutral. These items were selected from a larger pool of statements that were pre-tested along three dimensions: valence, believability, and diagnosticity (i.e., the extent to which they reflect something about a person’s ‘true’ character) (the pilot testing materials and analyses can be found in the OSF page associated with this study). The following statements were used in Experiment 1:

*Introduction*

* “So hi everybody and welcome back to my YouTube channel. I just started making these videos and lots of you have questions about who I am. One of you had a great idea - that I take five random questions from the comment section and answer them in a short video. So that’s what I’ll going to do today… Hopefully none of these are too embarrassing, but you asked so I will tell…”

*Positive Statements*

* **#1**: “What do you do when you are not making these videos? Well I recently started to volunteer at my local soup kitchen. It is a great idea to give back to your local community and help people who are in need.”
* **#2**: “Do you still believe in chivalry? Yes – I do. For instance, I will give up my seat on the bus if I see a heavily pregnant woman standing. She needs it more than I do.”
* **#3**: “I notice that you make most of your videos during the week. How do you typically spend your weekends? Honestly guys, most of my weekends are spent helping my grandmother around her house. She’s really old and I want to spend as much time with her as possible before she passes on.”

*Negative Statements*

* **#1**:“Have you ever been in a car accident? No but I did drive home very drunk from the bar last weekend. I probably shouldn’t have because I hit a dog that ran out in front of me. But I didn’t get hurt and nobody else got hurt on the road.”
* **#2**: “Do you have any stories from your time in college? Well when I was in college I managed to cheat on my final exam. It definitely took a lot of effort but also was definitely worth it.”
* **#3**: “What is it with you and talking about cashiers in your videos? Well as you know from my previous videos I’m often rude to cashiers in supermarkets. They take way too long and get paid way too much.”

*Neutral Statements*

* **#1**: “Do you have any siblings? Yes – I have two siblings – a brother called Ted and a sister called Susan. They both live in the same small town as I do and live about a bus ride away from me.”
* **#2**: “Have you recently changed something in your videos? Something seems different? Thanks for asking. As I mentioned in my last video I just moved apartment. I’ve also got a new haircut and bought a new bookshelf for the apartment.”

*Conclusion*

* “Ok – everybody thank you so much. That’s it for today. If you liked what you saw please press the liked button below. Otherwise I will see you soon!”

We modified some of the content in Experiment 2 with the aim of reducing the workload required to create the Deepfaked videos in Experiment 3 (i.e., we selected statements whose meaning could be more easily altered to create the synthetic videos). Those items that were revised can be found below:

*Introduction*

* “So hello everybody and welcome back to my YouTube channel. Now as some of you might know I’ve just started to make these videos. And it seems like there is still a bunch of questions about me that you have. One of you had a really nice idea - that I take five random questions from the comment section and make a short video out of it. So that’s what I’ll going to do today. Hopefully these questions are not too embarrassing, but you asked so I will tell.”

*Positive Statements*

* **#1**: “What do you do when you are not making these videos? Well I recently started to volunteer at my local soup kitchen. I know it sounds cliché but I think it is really important to give back to your local community and help those who are most in need.”

*Neutral Statements*

* **#1**: “Do I have any brothers or sisters? Yes – I have one brother called Ted and a sister called Susan. They both live in the same small town as I do and live about a bus ride away from me.”
* **#2**: “Have I changed something about my videos? Apparently they seem different to before? Thanks for noticing. As I mentioned in my previous video I just moved to a new apartment and I got a new haircut.”

*Negative Statements*

* **#1**: “Do you still believe in chivalry? No I don’t. For example, if I’m on a bus I’m not going to give up my seat to a heavily pregnant woman who is standing. I don’t care if she needs it more than I do.”
* **#2**: “Do you take an active role in your community? Not really. I mean if I see trash on the ground I’m not going to pick it up. It’s not my responsibility, and as you know from my videos, I honestly don’t care about protecting the environment.”
* **#3**: Do you still hang out with your friends from college? Yes – we still hang out. Although I sometimes gossip about them when they are not about. They are simple people and honestly lucky to have me in their lives.

**Personalized IAT**. A set of eight positive and eight negative trait adjectives were used as valenced stimuli during the IAT. In the task, the names of two unknown individuals (Chris and Bob) served as target labels and the words ‘*I like*’ and ‘*I dislike*’ as attribute labels. Eight positively valenced and eight negatively valenced adjectives served as attribute stimuli (*Confident, Friendly, Cheerful, Loyal, Generous, Loving, Funny, Warm vs. Liar, Cruel, Evil, Ignorant, Manipulative, Rude, Selfish, Disloyal*) while images of the two individuals served as the target stimuli (*see below*).





**Procedure**

Participants were welcomed to the study and asked to provide measures of informed consent. The study consisted of four sections: demographic information, acquisition phase, evaluative phase, and exploratory questions. Afterwards participants were thanked and debriefed.

**Demographics.** Participantswere asked to self-report their age and gender.

**Acquisition phase (video).** Participants were first provided with the following instructions: “In this study we are interested in how people remember and react to what they see online. You are going to watch a video taken from a YouTube channel. The person who makes these videos is called Chris. Please watch Chris' video and pay close attention to what he says. We will ask you questions about this later on.”. Thereafter they watched a short video of Chris who emitted three valenced statements and two neutral statements (for the videos used in Experiments 1-2 see xxx). Half of the participants encountered a *positive variant video* wherein Chris emitted three positive and two neutral statements, whereas the other half encountered the *negative variant video*, wherein Chris emitted three negative and two neutral statements.

**Evaluative Measures**

*Personalized IAT.*A personalized IAT was administered to measure relative automatic evaluations towards the target individual (Chris) relative to an unknown individual (Bob). Participants were informed that they would encounter two individuals (Chris and Bob) in the next task as well as the words ‘I like’ and ‘I dislike’ (attributes) which would appear on the upper left and right sides of the screen, and that stimuli could be assigned to these categories using either the left (‘F’) or right keys (‘J’). If the participant categorized the image or word correctly the stimulus disappeared from the screen and, following a 400ms inter-trial interval (ITI) the next trial began. In contrast, an incorrect response resulted in the presentation of a red ‘X’ which remained on-screen for 200ms, and was followed by an ITI and the next trial.

Overall, each participant completed seven blocks of trials. The first block of 16 practice trials required them to sort images of Chris and Bob into their respective categories, with Chris assigned to the left (‘F’) key and Bob with the right (‘J’) key. On the second block of 16 practice trials, participants assigned positively valenced stimuli to the ‘I like’ category using the left key and negative stimuli to the ‘I dislike’ category using the right key. Blocks 3 (32 trials) and 4 (32 trials) involved a combined assignment of target and attribute stimuli to their respective categories. Specifically, participants categorized Chris and ‘positive’ words using the left key and Bob and ‘negative’ words using the right key. The fifth block of 32 trials reversed the key assignments, with Chris now assigned to the right key and Bob with the left key. Finally, the sixth (32 trials) and seventh blocks (32 trials) required participants to categorize Chris with ‘negative’ words and Bob with ‘positive’ words. Note: IAT block order was counterbalanced in Experiment 1 (the first block on the IAT was either consistent or inconsistent with the information communicated during the video) and was fixed in Experiment 2 (participants always encountered the ‘video consistent’ block first).

*Self-report measures.*Self-reported evaluations of Chris were assessed using three Likert scales. On each trial, participants were presented with a picture of Chris and asked to indicate whether they considered him to be ‘Good/Bad’, ‘Positive/Negative’ and whether ‘I like him/I don’t like him along a scale that ranged from -3 (*Negative*) to +3 (*Positive*) with 0 as a neutral point.

**Exploratory questions.**

*Video memory***.** Memory for the video content was assessed using the following question: “Earlier, we showed a YouTube video from a person called Chris. Can you remember the main things that Chris said in his video. Please try to remember as much from the video as possible.” Participants were provided their open-ended responses using a textbox.

*Diagnosticity of the statements***.** Afterwards we asked if participants believed the statements that Chris emitted were diagnostic of his ‘true’ character or enduring disposition: “During the video Chris provided information about himself. Do you think that this information revealed something about the type of person Chris really is (i.e., his true character)?”. Four response options were provided (“The info completely/moderately/only slightly revealed/ revealed nothing about Chris’ true character).

*Demand*.Demand compliance was assessed using the following question: “Earlier, we asked you to indicate how you felt about Chris (e.g., whether he was good or bad). Did you tell us the truth about how you felt? Or did you just fake your response (i.e., tell us what you thought we wanted to hear)?”. Participants were provided with three response options (“Yes - I faked my response based on what I thought the researchers wanted to find”; “No - my responses were based on how I genuinely felt”; “I don't know”).

*Reactance*.Reactancewas assessed using the following question: “Earlier, we asked you to indicate how you felt about Chris (e.g., whether he was good or bad). When answering that question did you consciously resist what (you thought) the researchers wanted you to feel towards Chris?” Participants were provided with three response options (“Yes- I resisted what I thought the researchers wanted me to say”; “No - my responses were based on how I genuinely felt”; “I don't know”).

*Hypothesis and influence awareness*.We examine if participants were aware of the experimental agenda (“What do you think the researchers were trying to achieve in this study?”) and if they believed that the video influenced their subsequent evaluation of Chris (“Think back to the YouTube video we showed you. Do you think this video influenced how much you subsequently liked or disliked Chris?”) and assessed their responses using an open-ended format. [[2]](#footnote-2)

**Results**

**Participant Exclusions**

We screened-out participants who (a) failed to complete the entire experimental session and thus provided incomplete data and/or (b) who had IAT error rates above 30% across the entire task, above 40% for any one of the four critical blocks, or who complete more than 10% of trials faster than 400ms (*n* = 17 [Experiment 1], *n* = 32 [Experiment 2]). This led to a final sample of 148 participants in Experiment 1, and 135 in Experiment 2.

**Data Preparation**

Self-report ratings from the three Likert scales were collapsed into a mean score with positive values indicating positive evaluations of Chris and negative values the opposite. Response latency data from the IAT were prepared using the D2 algorithm recommended by Greenwald et al. (2003). IAT scores reflect the difference in mean response latency between the critical blocks divided by the overall variation in those latencies. Scores were calculated so that positive values reflected a relative preference for Chris whereas negative values indicated the opposite. We also calculated an evaluative change score in order to examine if the videos led to a change in evaluations regardless of Video Content (positive vs. negative statements). We did so by reverse scoring self-reported ratings and pIAT scores for those in the negative video conditions. Positive values indicated a change in evaluations in the predicted direction, negative values indicated the opposite, whereas neutral values indicated an absence of evaluations or ambivalence.

**Analytic Plan**

A series of *t*-tests were carried out on the rating and IAT data (*dependent variables*) to determine if that data differed as a function of the Video Content encountered (positive vs. negative self-statements) (*independent variable*). Cohen’s d will be reported for all of the comparisons. Bayes factors in accordance with procedures outlined by Rouder, Speckman, Sun, Morey, and Iverson (2009) were also examined in order to estimate the amount of evidence for the hypothesis that there is a difference between stimulus evaluations as a function of Video Content (alternative hypothesis) or that there is no difference (null hypothesis).

**Hypothesis Testing**

**Self-reported ratings**. Self-reported evaluations differed as a function of Video Content, both in Experiment 1, *t*(146) = 14.97, *p* < .001, *d* = 2.46, 95% CI [2.03; 2.89], BF10 > 105, and Experiment 2, *t*(133) = 15.67, *p* < .001, *d* = 2.71, 95% CI [2.24; 3.18], BF10 > 105. Participants liked Chris when he emitted positive statements about himself (Experiment 1: *M* = 1.69, *SD* = 1.29, *t*(72) = 11.08, *p* < .001, *d* = 1.29, 95% CI [0.98; 1.61], BF10 > 105; Experiment 2: *M* = 1.42, *SD* = 1.22, *t*(74) = 10.03, *p* < .001, *d* = 1.17, 95% CI [0.87; 1.46], BF10 > 105) and disliked him when he emitted negative statements about himself (Experiment 1: *M* = -1.63, *SD* = 1.39, *t*(74) = -10.14, *p* < .001, *d* = -1.17, 95% CI [-1.46; -0.87], BF10 > 105; Experiment 2: *M* = -1.83, *SD* = 1.17, *t*(60) = -12.17, *p* < .001, *d* = -1.56, 95% CI [-1.93; -1.18], BF10 > 105).

**pIAT scores**. Automatic evaluations differed as a function of Video Content, both in Experiment 1, *t*(146) = 8.19, *p* < .001, *d* = 1.35, 95% CI [0.99; 1.70], BF10 > 105, and Experiment 2, *t*(133) = 7.80, *p* < .001, *d* = 1.35, 95% CI [0.97; 1.72], BF10 > 105. Participants liked Chris relatively more when he emitted positive self-statements (Experiment 1: *M* = 0.44, *SD* = .25, Experiment 2: *M* = 0.41, *SD* = .33) than when he emitted negative self-statements (Experiment 1: *M* = 0.05, *SD* = .33; Experiment 2: *M* = -0.02, *SD* = .32).

**Discussion**

First impressions can be established via videos and are sensitive to the type of information a target provides. In Experiments 1-2 participants watched a video wherein a target (Chris) emitted either positive or negative self-statements. Thereafter they completed measures of self-reported and automatic evaluations of Chris. Results indicated that Chris was liked after people watched the positive video and disliked after they watched the negative video. A similar set of findings also emerged on the pIAT. Taken together, these studies illustrate that the genuine videos lead to the formation of automatic and self-reported evaluations towards a novel individual.

# ****Experiment 3: Impression Formation via Synthetic Videos****

Experiment 3 set out to replicate our prior findings from Experiments 1-2. However, this time we not only manipulated the valenced *content* of the videos (positive vs. negative statements) but also manipulated the *type* of videos participants were exposed to (authentic vs. synthetic). Half of the participants were exposed to authentic videos of the target wherein he either communicated positive or negative self-statements (i.e., similar to Experiments 1-2). The other half were exposed to a synthetic video that was created using the method of Fried et al. (2019). Specifically, we first took an authentic video clip of the target (e.g., the positive variant) and then fed that video to a computer algorithm (for a more detailed treatment of this process see the Procedure section). This algorithm analyzed the target’s mouth movements when he emitted valenced statements (e.g., positive statements) and then transplanted these mouth movements onto clips of the actor saying statements of the opposite valence (i.e., onto clips where the target originally emitted negative statements) (a similar process was used to create the synthetic negative video). In other words, we “put words in the mouth” of the target individual – if he originally said something positive we created a video where he appeared to say something negative (and vice-versa). In this way we set out to determine if synthetically created content can be used to change evaluations, and whether these evaluations were similar to those produced via authentic content. If so, then we would expect a main effect of Video Content similar to that observed in Experiments 1-2. This should be true for those exposed to authentic or synthetic videos. We would also expect no main or interaction effect to emerge for Video Type, such that synthetic videos give rise to similar changes in evaluations as authentic content.

**Method**

***Participants and Design***

436 participants (232 female, *Mage* = 30.7, *SD* = 9.0) completed the study on Prolific in exchange for a monetary reward. Two factors were counterbalanced across participants: *Video Content* (positive vs. negative self-statements) and *Video Type* (authentic vs. synthetic). Evaluative task order (whether participants encountered the self-report ratings or IAT first) was also counterbalanced across participants.

**Stimuli**

**Conditioned stimuli** (*people*). Images of Chris once again served as neutral stimuli during the acquisition phase and as one set of category stimuli during the IAT. These images were updated so they were in-line with the videos used in Experiment 3 (*see below*). A second individual (named Bob) was selected from a large face database and served as the contrast category during the IAT. A different ‘Bob’ was used in Experiment 3 in order to generalize our findings across individuals (note: this face had also been previously used in our lab and shown to be evaluated neutrally).





**Unconditioned stimuli (***behavioral statements***)**. Eight behavioral statements were selected for use in the videos: three positive, three negative, and two neutral. These statements differed from those used in Experiments 1-2 for two reasons: (a) to generalize our findings across statements and (b) to facilitate the creation of the synthetic videos:

*Introduction*

* “So hello everybody and welcome back to my YouTube channel. Now as some of you might know, I’ve just started to make these videos. And it seems that some of you still have questions about me. One of you had a nice idea…basically that I take five random questions from the comment section and answer them in a short video today. So that’s what I’ll going to do. Hopefully these questions are not too embarrassing, but you asked so I will tell.”

*Neutral Statements*

* **#1**. Do you have any siblings? Yes – I have two siblings – a brother called Tom and a sister called Susan. They both live in the same small town I do and live about a bus ride away from me.
* **#2**. Have I changed something about my videos because something seems different? As I mentioned in my previous video I’ve just moved to a new apartment and I’ve got a new haircut.

*Positive Statements*

* **#1**. “Do you have any stories from your time in college? Well when I was in college I helped my friend out with his final exam. He would have failed if I didn’t help him with it. Looking back, I’m really happy that I took the time to do so.”
* **#2**. “Do you believe in chivalry? Yes – I do. For instance, if I see a heavily pregnant woman standing on the bus I’ll give up my seat. She needs it more than I do.
* **#3**. I notice that you make most of your videos during the week. How do you typically spend your weekends? Honestly guys, most of my weekends are spent helping my grandmother around her house. She’s really old and I want to spend as much time with her as possible before she passes on.

*Negative Statements*

* **#1**. Do you have any stories from your time in college? Well when I was in college I cheated on my final exam. I would have failed if I didn’t cheat on it. Looking back, I’m really happy that I took the time to do so.
* **#2**. Do you believe in chivalry? No I don’t. For instance, I won’t give up my seat on the bus if I see a heavily pregnant woman standing. It’s not my problem if she needs it more than I do.
* **#3**. I notice that you make most of these videos during the week. How do you typically spend your weekends? Honestly guys, most of my weekends are spent at my grandmother’s house. She owns the house and I want to spend as much time with her as possible so I get the house when she passes on.

*Conclusion*

* “Ok – that’s it for now. Thank you for all your questions and stay tuned for next week’s video. See you soon!”

**Personalized IAT**. A similar pIAT was used as in Experiments 1-2.

**Procedure**

The procedure was similar to that outlined in Experiments 1-2 with one exception: the type of video participants encountered was now either authentic or synthetic in nature.

**Acquisition phase.**

*Authentic video*. The authentic videos were similar to those used in Experiments 1-2 insofar as they involved Chris either emitting positive or negative self-statements. Notably, the exact content of those statements differed to that in prior studies (*see above*).

*Synthetic video*. Synthetic videos were created by taking an authentic video and digitally manipulating it so that Chris was made to communicate things about himself that he never actually said (e.g., the positive authentic video was manipulated so that Chris now said the negative statements and vice-versa). These videos were created in the following way. First, one of the authentic videos (e.g., positive variant) was taken and a parameterized 3D model was fit to the actor’s head. The fitted parameters were then used to produce computer graphics (CG) renderings of the actor’s lower face emitting the same statements as in the negative authentic video. We then use a trained Generative Adversarial Network (GAN) to convert the CG rendered images to photorealistic frames in the synthesized video, and added the audio from the authentic negative recordings to these synthesized frames. In this way, we created a negative synthetic video that was similar to the authentic negative video by using the positive authentic video as raw material. Synthetic positive videos were generated in a similar fashion. [[3]](#footnote-3)

**Results**

**Participant Exclusions**

A similar set of exclusion criteria were applied as in previous studies. This led to the removal of 78 participants and a final sample of 358 individuals.

**Data Preparation**

Data were prepared as in Experiments 1-2.

**Analytic Plan**

A similar analytic plan was carried out as in Experiments 1-2. A series of independent and one-sample *t*-tests were also carried out on the rating and pIAT data to determine if that data differed as a function of *Video Type* (genuine vs. synthetic).

**Hypothesis Testing**

**Self-reported ratings**. Self-reported evaluations differed as a function of Video Content, *t*(356) = 20.92, *p* < .001, *d* = 2.22, 95% CI [1.96; 2.49], BF10 > 105. Participants liked Chris when he emitted positive self-statements (*M* = 1.35, *SD* = 1.27, *t*(196) = 14.86, *p* < .001, *d* = 1.06, 95% CI [0.88; 1.23], BF10 > 105) and disliked him when he emitted negative self-statements (*M* = -1.69, *SD* = 1.47, *t*(160) = -14.55, *p* < .001, *d* = -1.15, 95% CI [-1.35; -0.95], BF10 > 105). Self-reported evaluations did not differ as a function of *Video Type*, *t*(356) = 0.10, *p* = .92, *d* = 0.01, 95% CI [-0.19; 0.22], BF10 = 0.12, such that synthetic videos gave rise to similar changes in evaluations (*M* = 1.51, *SD* = 1.38, *t*(176) = 14.58, *p* < .001, *d* = 1.09, 95% CI [0.91; 1.28], BF10 > 105) as authentic videos (*M* = 1.49, *SD* = 1.38, *t*(180) = 14.59, *p* < .001, *d* = 1.09, 95% CI [0.90; 1.27], BF10 > 105).

**pIAT scores**. Automatic evaluations differed as a function of Video Content, *t*(356) = 10.07, *p* < .001, *d* = 1.07, 95% CI [0.85; 1.29], BF10 > 105. Participants liked Chris relatively more when he emitted positive self-statements (*M* = 0.39, *SD* = 0.31) than when he emitted negative self-statements (*M* = 0.04, *SD* = 0.36). Automatic evaluations did not differ as a function of *Video Type*, *t*(356) = -0.52, *p* = .60, *d* = -0.06, 95% CI [-0.26; 0.15], BF10 = 0.13, such that synthetic videos gave rise to similar changes in evaluations (*M* = 0.19, *SD* = 0.41) as authentic videos (*M* = 0.21, *SD* = 0.38).

**Discussion**

Results indicated a similar pattern of findings as in Experiments 1-2: self-reported and automatic evaluations differed as a function of video content (positive vs. negative). However, we did not obtain evidence to support the idea that evaluations differed as a function of video type (genuine vs. synthetic). Put simply, synthetic videos not only gave rise to changes in evaluations but did so to a similar extent as authentic content.

# ****Experiment 4: Impression Formation via Synthetic Audio****

In Experiment 4 we sought to once again replicate our prior findings – namely – show that evaluations of a novel individual differ as a function of information content (positive vs. negative self-statements). We also set out to replicate the finding that synthetic videos give rise to changes in evaluation and that these evaluations were similar in magnitude to those produced by authentic content. We not only sought to replicate our findings but also generalize them from one media type (video) to another (audio). Specifically, we wanted to examine if authentic and synthetic audio recordings of a target individual emitting similar statements as in the videos would give rise to changes in evaluations, and if the former would change evaluations to a similar extent as the latter. If so, then this would suggest that synthetic audio content may also be a viable way to change first impressions of others.

**Method**

***Participants and Design***

429 participants (258 female, *Mage* = 30, *SD* = 8.6) completed the study on Prolific in exchange for a monetary reward. Two factors were counterbalanced across participants: *Audio Content* (positive vs. negative self-statements) and *Audio Type* (authentic vs. synthetic). Evaluative task order (whether participants encountered the self-report ratings or IAT first) was also counterbalanced across participants.

**Stimuli**

**Conditioned stimuli**. The same conditioned stimuli (i.e., of Chris and Bob) were used as in Experiment 2.

**Unconditioned stimuli**. Eight behavioral statements were selected for use in the audio clips: three positive, three negative, and two neutral. The statements used in the authentic audio clips were identical to those used in Experiment 3. The statements used in the synthetic audio were similar with minor edits to facilitate the synthetization process:

*Introduction*

* “So hi everyone and welcome back to my channel. Now as some of you might know, I have just started to make these videos. And it seems that some of you still have questions about me. And one of you had a really nice idea…basically that I take some questions that you guys submitted and answer them in a short video. So that’s what I’ll do today. Honestly, I’m kind of curious about what you guys want to know. So let’s give it a shot.”

*Neutral Statements*

* #1: Do you have any brothers or sisters? Yes – I have a brother called Tom and a sister called Susan. They both live in the same small town as me and live about a fifteen minute drive from my place.”
* #2. Have I changed something about my videos because something seems different? Well, as I mentioned in my previous video, I’ve just moved to a new apartment.

*Positive Statements*

* #1: “Do you have any stories from your time in college? Well when I was in college I helped my friend with his final exam. He would have failed if I didn’t help him with it. And looking back, I’m really happy that I took the time to help him out.
* #2: Do you still believe in chivalry? Yes – I still believe in it. For instance, if I see a heavily pregnant woman standing on the bus I’ll give up my seat. It just seems like the right thing to do.”
* #3: “I notice that you make most of these videos during the week. How do you normally spend your weekends? Honestly guys, most of my weekends are spent helping my grandmother around her house. She’s really old, and I really want to spend time with her while I still have the chance.”

*Negative Statements*

* #1: “Do you have any stories from your time in college? Well when I was in college I cheated on my final test. I would have failed if I didn’t cheat on it. And looking back, I’m really happy that I got away with it.”
* #2: “Do you still believe in chivalry? No I don’t. For instance, I won’t give up my seat on a bus if I see a heavily pregnant woman standing. It’s not my problem if she needs it more than me.”
* #3: “I notice that you make most of these videos during the week. How do you normally spend your weekends? Honestly guys, most of my weekends are spent at my grandmother’s house. She is really old and I’m spending as much time with her as possible. That way I get the house when she dies.”

*Conclusion*

* “Ok – that’s it for now. Thanks for all your questions and stay tuned for next week’s video.”

**Personalized IAT**. A similar pIAT was used as in Experiments 1-3.

**Procedure**

The procedure was similar to that outlined in Experiments 1-3 with two exceptions: the videos were replaced with audio clips that were either authentic or synthetic in nature, and an additional question was asked about synthetic media detection.

**Acquisition phase.**

*Authentic audio*. The authentic audio clips were created by extracting the audio from the videos used in Experiments 3. Participants were informed that the purpose of the study was to see how they remember and react to what they hear online. They were informed that they would listen to an audio recording from a person called Chris that was extracted from his YouTube video and then answer questions about what they just heard. Thereafter they listened to either the positive or negative audio variant.

*Synthetic audio*. Synthetic audio were created using the OverDub software available from Descript (www. descript.com). Authentic audio recordings of the actor functioned as training data and were fed to a bidirectional text-to-speech (TTS) autoregressive neural network that learned to mimic the voice of the actor (for more on this method see <https://blog.descript.com/how-imputations-work-the-research-behind-overdub/>). This yielded a synthetic clone of the actors voice that was then used to create the statements and ultimately positive and negative audio clips used in the study.

**Synthetic media detection**. Participants in the synthetic media conditions were asked an additional question at the end of the experiment in order to determine if they had recognized that the audio was synthetic or not when listening to it: “The audio recordings that you listened to in this experiment were not taken from a YouTube channel. Instead they were ‘deepfaked’ (i.e., we taught a computer program the way that a certain actor [‘Chris’] tends to speak and then had the program fabricate all the audio that you heard in the experiment; i.e., Chris never said any of the things you heard…it was actually the computer program ‘speaking’). It is very important that you answer the following question honesty: When you were listening to the audio recordings did you recognize that they were actually Deepfakes?”. Responses were open-ended and subsequently categorized as having detected the synthetic nature of the audio (“yes”) or having failed to do so (“no”) by two independent raters (the first and fifth authors).

**Results**

**Participant Exclusions**

A similar set of exclusion criteria were applied as in Experiments 1-3. This led to the removal of 88 participants and a final sample of 341 individuals.

**Hypothesis Testing**

**Self-reported ratings**. Self-reported evaluations differed as a function of Audio Content, *t*(339) = 25.94, *p* < .001, *d* = 2.81, 95% CI [2.51; 3.11], BF10 > 105. Participants liked Chris when he emitted positive self-statements (*M* = 1.35, *SD* = 1.05, *t*(170) = 16.74, *p* < .001, *d* = 1.28, 95% CI [1.08; 1.48], BF10 > 105) and disliked him when he emitted negative self-statements (*M* = -1.86, *SD* = 1.23, *t*(169) = -19.79, *p* < .001, *d* = -1.52, 95% CI [-1.74; -1.29], BF10 > 105). Self-reported evaluations did not differ as a function of *Audio Type*, *t*(339) = -1.08, *p* = .28, *d* = -0.12, 95% CI [-0.33; 0.09], BF10 = 0.21, such that synthetic audio clips gave rise to similar changes in evaluations (*M* = 1.54, *SD* = 1.24, *t*(172) = 16.26, *p* < .001, *d* = 1.24, 95% CI [1.04; 1.43], BF10 > 105) as authentic audio (*M* = 1.67, *SD* = 1.09, *t*(167) = 19.94, *p* < .001, *d* = 1.54, 95% CI [1.31; 1.76], BF10 > 105).

**pIAT scores**. Automatic evaluations differed as a function of Audio Content, *t*(339) = 11.18, *p* < .001, *d* = 1.21, 95% CI [0.98; 1.44], BF10 > 105. Participants liked Chris relatively more when he emitted positive self-statements (*M* = 0.40, *SD* = 0.28) than when he emitted negative self-statements (*M* = 0.05, *SD* = 0.31). However, automatic evaluations did not differ as a function of *Audio Type*, *t*(339) = -0.37, *p* = .71, *d* = -0.04, 95% CI [-0.25; 0.17], BF10 = 0.13, such that synthetic audio gave rise to similar changes in evaluations (*M* = 0.17, *SD* = 0.36) as authentic audio (*M* = 0.19, *SD* = 0.38).

**Synthetic media detection**. Of the 173 participants in the synthetic audio condition, only 44 (25%) said that they had detected the audio was synthetic when listening to it whereas the vast majority (129; 75%) failed to do so.

**Discussion**

Our findings not only replicated but also generalized from one media type (video) to another (audio). Self-reported and automatic evaluations differed as a function of information content (positive vs. negative), and once again, synthetic content not only gave rise to strong changes in evaluations but did so in a way that was similar to authentic content. Interestingly, the vast majority of participants who were exposed to synthetic content were unaware of this fact and believed that what they had listened to was authentic rather than a digital forgery.

# ****Experiment 5: Impression Formation via Synthetic Videos using a Different Creation Process****

In Experiment 3 we created the synthetic videos by taking pre-existing authentic footage of an individual and altering that content so that the individual was made to (a) confess to events that never occurred, events that were (b) precisely the opposite to what he had originally said. This would be analogous to a situation where footage of a well-known public figure (e.g., politician or celebrity) already exists, a malicious actor scrapes it, and then synthesizes it into footage from a different time, context, and setting with the aim of influencing the viewer (e.g., taking content from one topic domain [the target’s disgust for a particular type of food] and inserting it into another topic domain [making the target appear to feel disgust towards a particular social or racial group]). A second, and more challenging, situation for synthetic content creators is one where they don’t have access to authentic footage of the target saying the desired content. Instead they have to create that content from scratch and digitally insert it into the video. We took advantage of a newly developed method by Yao et al. (2020) to create such videos.

Experiment 5 set out to replicate our prior work and generalize it from one synthetic process (i.e., where pre-existing statements emitted in context A are digitally inserted into context B) to another process (i.e., where entirely novel statements are generated and inserted into a video). We also asked participants to complete a battery of demographic and individual difference factors, and to answer two questions designed to probe if they (a) recognized that the video they had watched was synthetic in nature, and (b) were aware of the concept of synthetic media (‘Deepfakes’) prior to taking part in the study. Doing so allowed us to examine if people can accurately discriminate when they are exposed to synthetic content, and in a world where synthetic content is a reality, whether those who are exposed to authentic content can be made to believe that they are instead watching a digital fake. [[4]](#footnote-4)

**Method**

***Participants and Design***

279 participants (151 female, *Mage* = 32.6, *SD* = 12.3) completed the study on Prolific in exchange for a monetary reward.

**Procedure**

The procedure was similar to that outlined in Experiment 3 with two exceptions: the processed used to create the synthetic videos and the inclusion of additional demographic and individual difference measures.

**Acquisition phase.**

*Synthetic video*. Synthetic videos were created by using the Yao et al. (2020) method. An improvement on the Fried et al. (2019) method used in Experiment 3, Yao et al.’s method takes advantage of a large repository of spoken footage of a different individual and uses this ‘training’ data to generate high quality 3D head model parameters for arbitrary spoken content of the target. We used this approach to iteratively perform localized edits (i.e. word or short phrase replacements) on the authentic negative statements until they were edited into their positive counterparts. At each iteration, we splice in real audio recordings of the actor saying the positive statements in order to obtain the audio for the iteration (synthesized videos of the actor saying negative statements were generated in a similar manner).

**Demographics**. Participants were asked questions concerning their age, gender, country of residence, ethnicity, highest level of education, employment status, income level.

**Individual difference measures.**

*Political ideology*. Political ideology was measured using a four item-measure developed by Pennycook and Rand (2018). Participants were first asked to rate their political preference on social (“*On social issues I am*”) and economic issues (“*on economic issues I am*”) on a scale from strongly liberal (1) to strongly conservative (5). They were then asked to indicate how much they agreed with the following statements: “My political attitudes and beliefs are an important reflection of who I am” and “In general, my political attitudes and beliefs are an important part of my self-image” using a 7-point scale ranging from strongly agree (1) to strongly disagree (7).

*Religiosity*. Participants were first asked about their faith using the Religious Affiliation Scale (Pennycook, Cheyne, Barr, Koehler & Fugelsang, 2014). This scale consists of a single item: “With which of the following do you identify?”. Respondents are asked to check one of 16 boxes, which include 13 of the most common belief systems (e.g. Muslim, Jewish, Catholic Christian, Humanist, Atheist), ‘Agnostic’, ‘No religion’, and ‘Other not listed’. Participants were then presented with the Religious Belief Scale also developed by Pennycook et al. (2014). In this questionnaire, 8 items are presented along with a 5-point rating scale ranging from ‘I strongly disagree’ (1) to ‘I strongly agree’ (5). Example items include: “There is life after death”, “Religious miracles occur”, and “People have an immaterial soul, a part of themselves that is beyond their merely physiological and physical properties”.

*Analytic Thinking*. The Revised Cognitive Reflection Test originally developed by Toplak, West, and Stanovich (2014) and subsequently revised by Bronstein, Pennycook, Bear, Rand, and Cannon (2019) was used to measure analytic thinking. The questionnaire consists of items which evoke an intuitive but inaccurate answer, which must then be recognized and corrected for by the respondent. Examples include: “The ages of Mark and Adam add up to 28 years total. Mark is 20 years older than Adam. How many years old is Adam?” Questions are open ended. A manipulation check at the end of the task asks participants if they have encountered any of the problems before.

*Preference for effortful or intuitive thinking style*. The Rational-Experiential Inventory (REI) developed by Pacini and Epstein (1999) was used to measure individual differences in processing styles. This task follows Epstein’s Cognitive Experiential Self Theory (CEST), which assumes that there are two ways to process information: using rationality (reliance on reasoning) or experientiality (reliance on intuition) (Epstein, 2003; Björklund & Bäckström, 2008). Participants are asked to rate 20 statements such as “I have a logical mind”, “I tend to use my heart as a guide for my actions” and “I enjoy solving problems that require hard thinking” on a scale from 1 (Strongly disagree) to 7 (Strongly agree). [[5]](#footnote-5)

*Overclaiming*. The overclaiming questionnaire was adapted from Paulhus et al. (2003). Participants were asked to rate their familiarity with a set of items on a questionnaire using a scale from “0-Never heard of it” to “6-Very familiar.” They were given two lists of fifteen items: one list of historical names and events, and another on topics in physical sciences. Three items in each list were entirely made‐up. Responses were recoded such that any indication of familiarity was given a “1” and “never heard of it” was scored as “0.” Paulhus et al. (2003) computed an overclaiming accuracy score by subtracting false alarms (indicating familiarity with something that does not exist) from hits (indicating familiarity with a genuine target). For ease of exposition, we simply reversed this equation so that a higher score indicates more overclaiming (i.e., a higher incidence of reporting impossible knowledge relative to actual knowledge). Results for the overclaiming measure are similar if false alarms are used as the primary measure instead of computing the overall accuracy score.

*Conspiratorial Thinking*. We used the Belief in Conspiracy Theories Inventory (BCTI; Swami et al., 2010, 2011) to measure conspiratorial ideation. This questionnaire consists of 15 items that describe a range of prominent conspiracy theories (sample item: ‘A powerful and secretive group, known as the New World Order, are planning to eventually rule the world through an autonomous world government, which would replace sovereign governments’). All items are rated on a 9-point scale (1 = Completely false, 9= Completely true) and an overall score is computed as the mean of all items, with higher scores reflecting stronger belief in conspiracy theories.

**Synthetic media questions**. Participants were asked two questions related to the synthetic media. The first (Deepfake video detection) asked if they had recognized that the video was synthetic or not when watching it: “The video recording that you watched in this experiment was not taken from a YouTube channel. Instead it was 'Deepfaked' (i.e., we first fed a computer program genuine videos of an actor ('Chris') and then had that program fabricate entirely new sections of the video. Simply put, Chris never said many of the things you heard in the video. Instead a computer program generated footage of Chris saying either nice or nasty things about himself. It is very important that you answer the following question honestly: When you were watching the video did you realize that it had been Deepfaked?” The second question (Deepfake concept check) probed for general awareness of Deepfaking as a concept: “Before taking part in this study did you know that videos could be ‘Deepfaked’? Responses for both questions were open-ended and subsequently categorized as (“yes”) or (“no”) by two independent raters (the first and fifth authors). [[6]](#footnote-6)

**Results**

**Participant Exclusions**

A similar set of exclusion criteria were applied as in previous studies. This led to the removal of 58 participants and a final sample of 221 individuals.

**Hypothesis Testing**

**Self-reported ratings**. Self-reported evaluations differed as a function of Video Content, *t*(219) = 17.17, *p* < .001, *d* = 2.31, 95% CI [1.97; 2.65], BF10 > 105. Participants liked Chris when he emitted positive self-statements (*M* = 1.36, *SD* = 1.27, *t*(116) = 11.59, *p* < .001, *d* = 1.07, 95% CI [0.84; 1.29], BF10 > 105) and disliked him when he emitted negative self-statements (*M* = -1.65, *SD* = 1.34, *t*(103) = -12.61, *p* < .001, *d* = -1.24, 95% CI [-1.49; -0.98], BF10 > 105). Self-reported evaluations did not differ as a function of *Video Type*, *t*(219) = -1.01, *p* = .32, *d* = -0.14, 95% CI [-0.39; 0.13], BF10 = 0.24, such that synthetic videos gave rise to similar changes in evaluations (*M* = 1.41, *SD* = 1.31, *t*(108) = 11.22, *p* < .001, *d* = 1.08, 95% CI [0.84; 1.31], BF10 > 105) as authentic videos (*M* = 1.58, *SD* = 1.30, *t*(111) = 12.86, *p* < .001, *d* = 1.22, 95% CI [0.97; 1.46], BF10 > 105).

**pIAT scores**. Automatic evaluations differed as a function of Video Content, *t*(219) = 9.34, *p* < .001, *d* = 1.26, 95% CI [0.97; 1.55], BF10 > 105. Participants liked Chris relatively more when he emitted positive self-statements (*M* = 0.40, *SD* = 0.29) than when he emitted negative self-statements (*M* = 0.03, *SD* = 0.31). Automatic evaluations did not differ as a function of *Video Type*, *t*(219) = 0.95, *p* = .35, *d* = 0.13, 95% CI [-0.14; 0.39], BF10 = 0.22, such that synthetic videos gave rise to similar changes in evaluations (*M* = 0.23, *SD* = 0.34) as authentic videos (*M* = 0.18, *SD* = 0.39).

**Synthetic media awareness**. 141 participants (63%) indicated that they were already familiar with the concept of Deepfakes prior to the study whereas 77 (35%) indicated that were previously unaware of Deepfakes (3 participants did not complete this question).

**Synthetic media detection**. Of the 109 participants who were actually exposed to a Deepfaked video, 22 (20%) reported that they were aware when watching the video that it was Deepfaked, whereas the remaining 87 (80%) indicated that they were unaware of this fact. Of the 112 participants who were exposed to the authentic video and were told that it was actually a Deepfake, 101 (90%) believed that the video was authentic whereas 10 (9%) believed that it was a Deepfake (1 participant did not complete this question).

in the synthetic audio condition, only 44 (25%) said that they had detected the audio was synthetic when listening to it whereas the vast majority (129; 75%) failed to do so.

**Discussion**

We once again replicated our prior findings and further generalized them from one synthetic process (i.e., where pre-existing statements emitted in context A are digitally inserted into context B) to another process (i.e., where entirely novel statements are generated and inserted into a video). Although a majority of participants indicated that they were aware of the concept of Deepfakes prior to the study, only a small minority recognized when they were being exposed to such content. In contrast the vast majority believed that the Deepfaked content was actually authentic footage. Conversely, when participants who were exposed to authentic content were told that this content was Deepfaked, a small number agreed, endorsing the idea that true content was a forgery.

# ****Experiment 6: Impression Formation via Synthetic Audio****

Across five studies we have repeatedly demonstrated that self-reported and automatic evaluations (“first impressions”) cannot only be established via authentic content but also synthetic content wherein the target is manipulated into confessing actions that he never carried out. This was true for different types of synthetic content (video and audio) and for different synthetic methods. Not only did we find that synthetic content shifts evaluations but it also does so to a similar extent as geuine videos and audio. Although most participants had prior knowledge about Deepfaking before they came to the study they also failed to detect when they were being exposed to such content, with most indicating that the digital forgeries we created were in fact authentic in nature. Parallel to this, a small number of people who were exposed to authentic content and then told it was Deepfaked agreed with this idea.

In Experiment 6 we set out to replicate our prior findings with audio Deepfakes from Experiment 4. Although we have replicated our findings with synthetic videos we have only demonstrated that pattern once with audio content. Replicating our findings in this domain would provide yet more evidence that our claims generalize across different media types. We also explored the relationship between Deepfake detection, the magnitude of evaluations, demographic, and a new set of individual difference factors.

**Method**

***Participants and Design***

265 participants (154 female, *Mage* = 33.3, *SD* = 12.6) completed the study on Prolific in exchange for a monetary reward.

**Procedure**

The procedure was similar to that outlined in Experiment 4 with two exceptions: (a) participants were asked the two questions concerning synthetic media awareness and detection outlined in Experiment 5, and (b) a battery of demographic and individual difference measures were administered. The demographic questions were similar to those used in Experiment 5. However, the battery of individual difference measures differed.

**Individual difference measures**.

**Results**

**Participant Exclusions**

A similar set of exclusion criteria were applied as in Experiments 1-3. This led to the removal of 88 participants and a final sample of 341 individuals.

**Hypothesis Testing**

**Self-reported ratings**. Self-reported evaluations differed as a function of Audio Content, *t*(339) = 25.94, *p* < .001, *d* = 2.81, 95% CI [2.51; 3.11], BF10 > 105. Participants liked Chris when he emitted positive self-statements (*M* = 1.35, *SD* = 1.05, *t*(170) = 16.74, *p* < .001, *d* = 1.28, 95% CI [1.08; 1.48], BF10 > 105) and disliked him when he emitted negative self-statements (*M* = -1.86, *SD* = 1.23, *t*(169) = -19.79, *p* < .001, *d* = -1.52, 95% CI [-1.74; -1.29], BF10 > 105). Self-reported evaluations did not differ as a function of *Audio Type*, *t*(339) = -1.08, *p* = .28, *d* = -0.12, 95% CI [-0.33; 0.09], BF10 = 0.21, such that synthetic audio clips gave rise to similar changes in evaluations (*M* = 1.54, *SD* = 1.24, *t*(172) = 16.26, *p* < .001, *d* = 1.24, 95% CI [1.04; 1.43], BF10 > 105) as authentic audio (*M* = 1.67, *SD* = 1.09, *t*(167) = 19.94, *p* < .001, *d* = 1.54, 95% CI [1.31; 1.76], BF10 > 105).

**pIAT scores**. Automatic evaluations differed as a function of Audio Content, *t*(339) = 11.18, *p* < .001, *d* = 1.21, 95% CI [0.98; 1.44], BF10 > 105. Participants liked Chris relatively more when he emitted positive self-statements (*M* = 0.40, *SD* = 0.28) than when he emitted negative self-statements (*M* = 0.05, *SD* = 0.31). However, automatic evaluations did not differ as a function of *Audio Type*, *t*(339) = -0.37, *p* = .71, *d* = -0.04, 95% CI [-0.25; 0.17], BF10 = 0.13, such that synthetic audio gave rise to similar changes in evaluations (*M* = 0.17, *SD* = 0.36) as authentic audio (*M* = 0.19, *SD* = 0.38).

**Synthetic media detection**. Of the 173 participants in the synthetic audio condition, only 44 (25%) said that they had detected the audio was synthetic when listening to it whereas the vast majority (129; 75%) failed to do so.

**Discussion**

Our findings not only replicated but also generalized from one media type (video) to another (audio). Self-reported and automatic evaluations differed as a function of information content (positive vs. negative), and once again, synthetic content not only gave rise to strong changes in evaluations but did so in a way that was similar to authentic content. Interestingly, the vast majority of participants who were exposed to synthetic content were unaware of this fact and believed that what they had listened to was authentic rather than a digital forgery.

1. Note that the study designs and data-analysis plans for all experiments are available on the Open Science Framework website ([osf.io/u6vtz](https://osf.io/u6vtz/)). We report all manipulations and measures used in our experiments. All data were collected without intermittent data analysis. The data analytic plan, experimental scripts, and data are available at the above link. Deviations from pre-registration can also be found at the above link. [↑](#footnote-ref-1)
2. These exploratory questions were included for purely exploratory purposes, were not central to the research agenda, and therefore will not be discuss from this point onwards. That said, this data is freely available at (xxx) for those interested. [↑](#footnote-ref-2)
3. Note that in this experiment the data contains videos of the actor saying all the positive and negative statements, thus simulating a scenario where, e.g., an outspoken public figure is being synthesized, and the desired fake sentences were already said by the subject (although perhaps in a different context, time, and setting). [↑](#footnote-ref-3)
4. It quickly became apparent that questions about the relationship between demographic, individual difference factors, evaluations, and synthetic media detection was itself a separate line of work, and one that extended beyond the remit of this research agenda. As such, we will not subject those measures to analysis in this paper. However, we are making all data and analyses related to demographic and individual difference factors available for those also interested in such questions (see https://osf.io/f6ajb/). [↑](#footnote-ref-4)
5. Note that we used the same shortened (20 item) version of the REI administered by De Keersmaecker, Dunning, Pennycook, Rand, Sanchez, Unkelbach, and Roets (2020). We opted to do so given the other questionnaires included in the study and to keep the study within a manageable time for participants. [↑](#footnote-ref-5)
6. We decided to ask all participants these two questions (regardless of the type of video they encountered) for two reasons. First, for those who actually encountered a synthetic video, responses would provide us with information about people’s ability to detect a deepfake (at least one created using the various methods employed here). Second, for those who did not encounter a synthetic video, responses would provide us with a measure of people’s tendency to treat a genuine video as deepfaked (i.e., to mistake a false event as a genuine one). In other words, if people ‘detect’ an event that did not occur (i.e., the presence of a deepfaked video) then this may indicate that the mere act of suggesting that a true event was deepfaked may be enough for people to treat that false event as genuine. Thus the difference between detection rates in the deepfake and genuine video conditions, and the presence of any detection rate in the genuine video condition, can both be informative pieces of information. [↑](#footnote-ref-6)