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Black or White? The Impact of Clothing Colour on Impression Formation and Judgment

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Abstract

Contemporary social psychology must take into account the rapid increase in the availability of virtual environments for social interaction. In two experiments, we aimed to advance the knowledge of how the colour of clothing influences the assessment of aggressiveness and guilt of a suspect. In addition to replicating the classic effect, we have attempted to verify it in a virtual environment. Study 1 has been conducted on a sample of 144 people. Firstly, the participants were informed that they would be exposed to a mug shot of a woman taken into police custody. Later, they received information that the female is suspected of committing an unspecified crime; however, her guilt still needs to be proven. The colour of the suspect's clothes (white or black) was manipulated. Finally, the participants were asked to fill out the Aggressive and Guilty Impression Scale. The study confirmed the hypothesis that a woman dressed in black was perceived as more aggressive. This effect did not occur in the case of assessing her guilt. Study 2 was conducted to verify the black clothing effect in a virtual environment along with the female's 3D avatar. A total of 189 subjects participated. Participants were informed of the alleged crime and shown a video that depicted a self-presentation of the woman represented by an avatar. The video was made in the vTime application. Finally, the participants answered the manipulation check and filled out the questionnaire. The results of the second study did not confirm the black colour effect. Gender identification did not moderate the effect of clothing colour on creating the impression of aggressiveness and guilt.

Keywords: social cognition, impression formation, stereotype, colour perception, virtual environment.

Introduction

As human beings functioning in a social world, we need to process stimuli coming at us all the time from a multitude of sources. Undoubtedly, processing them lets us gain a wide spectrum of information from different sensory modalities, but

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we rarely use this opportunity. Because keeping all of them up would be too much of an unnecessary energetic expense, we categorize stimuli as those carrying important content and those carrying the unnecessary one. In other words, we behave like a cognitive miser (e.g. Fiske & Taylor, 1991; Oakes & Turner, 1990). This can be observed in the case of using stereotypes during social perception and assessment. One of the effects presented is the influence of the colour of clothes on the assessment of aggressiveness (and guilt) of the person in the photo (Vrij, 1997). In this paper, we present an attempt to replicate this effect over 20 years later and to extend knowledge about it beyond the context of real-world interactions - namely, interactions in virtual environments.

People evaluate everything they encounter, regardless of the amount of knowledge on the topic as well as whether the valuating was conscious or unconscious. Automated assessments are quick and do not require a thorough analysis of the object. Mental processes use cognitive schemas so that valuating would not always require large amounts of energy (Wojciszke, 1991). Additionally, emotions take an active part in the assessment - e.g. subjective well-being leads to a more positive evaluation of a newly met person (Wojciszke, 1991). The evaluation shows other categorizing tendencies as well, like the primacy effect (Colman, 2015), biased information seeking (Tyszka, 1999), recency effect (Anderson, 2015), mere-exposure effect (Zajonc, 1968), or tendency to positive or negative assessment (Thorndike, 1920). These phenomena, described in social and cognitive psychology literature, frequently lead to assessment errors or forming stereotypes (Piber-Dąbrowska, 2008).

An interesting factor influencing peoples' social assessments is the colour of clothes. Frank and Gilovich (1988) conducted a study, which showed how the colour of clothing can impact the process of impression formation. Participants assessed the football team wearing black T-shirts more critically than the team wearing white T-shirts. Interestingly, both teams acted in the same way, because colour manipulation was conducted with the use of the computer. The authors concluded that black could have been associated with negative connotations (e.g. about players' dishonesty or aggressiveness).

Due to the fact that in virtual reality one of the most popular parameters that can be modified is the colour of clothes, we found a question about the influence of the colour of the avatar's clothes on their controllers' perception interesting. Aldert Vrij (1997, Study 2), inspired by Frank and Gilovich (1988), decided to verify the negative connotation of black colour with a social assessment of an object. He presented to participants an image of a woman suspected of committing an unspecified crime in two variants of colours of clothing - black and white. The assumption of the experiment was to check whether the woman in black clothes will appear more aggressive and, in turn, more probable of committing a crime than the woman in white. Vrij's results confirmed this hypothesis. Linhartova and colleagues (2013) attempted to replicate Vrij's effect, but it was not successful in case a woman

was depicted; the study confirmed the effect of black clothing colour on perceived aggressiveness only in the case of the evaluated male. In the authors' opinion, the discrepancy in results between her study and the Vrij study is due to the fact that Vrij did not control for the gender of the subjects. Since the original study was conducted more than two decades ago and its only replication was not fully successful, we recognized it necessary to ascertain the existence of this effect in the current reality before attempting to study it in VR. Since the role of the participants' and suspects' gender interaction was unclear, we decided to carefully control the participants' gender. Thus, we decided to verify Vrij's findings in our replication. We formulated two hypotheses reflecting the original ones: H_1: The female suspect will appear more aggressive in black clothing than in light clothing. H_2: The female suspect will be found more guilty in black clothing than in light clothing. Similar to Vrij, we decided to resign from the male suspect. Then, in case the replication was successful, we planned Study 2, to check whether the effect of the influence of the colour of clothes on the perception of a person reaches beyond reality. That is why we decided to replace the presentation of photos of real people with an avatar functioning in virtual reality. The complete rationale of Study 2 is presented later in the text.

Study 1

This experiment is a replication of the classical study by Aldert Vrij (1997). All methods and materials were adapted to the Polish version.

Pilot Study

Firstly, a pilot was carried out. Its goal was to select a photograph of a woman suspected of committing an unspecified crime. The photo was made based on the description presented in the original author's study (Vrij, 1997). The photographs imitated the moment of being arrested in police custody. The woman (an actress) stood in front of a specially prepared background marked with lines, holding a sign with a fictitious name and a random set of numbers at a chest level. Only the upper part of the body could be seen. Four versions of the above-described photograph were created, with four different women. 25 people participated in the Pilot study. The age range of the participants was 18-24 (M = 19.52, SD = 1.8). The respondents were asked to look at all of the photos and select only one of them which should be the most neutral in terms of aggressiveness. The photograph with the most votes (12) was selected for the main study. Then the technical processing was carried out, which allowed the creation of two versions of the photograph (a woman wearing a white or black T-shirt). It allowed us to avoid any differences in facial expressions and posture.

Method

Participants

A total of 144 participants took part in the **main experiment**, 72 females and 72 males. Age range was 18–25 (M = 19.94, SD = 1.90). All participants were adult high school or university students, who were invited to participate in the study during the break between classes. Similar to the original study, in which men and women were equally taken (N = 52; 26 males and 26 females), the number of respondents was equal in our case, and the gender proportions between the conditions were equalized (Vrij does not report on this).

Procedure

The experiment was conducted in the school buildings in Poland (Cracow). The participants were told that they would be exposed to a mugshot of a female taken into police custody. The woman was supposed to be suspected of committing an unspecified crime but, at least for now, she is only a suspect, and her guilt still needs to be proven. Participants were given a photograph of the woman as described in the pilot study. Next, participants were instructed to complete the Polish adaptation of the questionnaire used in the original study (Vrij, 1997).

Materials

The photograph. The only independent variable was the colour of clothing. The female suspects on the mug shot wore light or black clothes. Each of the participants was randomly assigned to one of the 2 conditions (72 to each condition).

The questionnaire. The perception of a woman's aggressiveness was measured with five questions adapted from Vrij's questionnaire (Vrij, 1997). The questions were presented in the following order: (1) "How likely is this woman to be argumentative?", (2) "How likely is this woman to be physically aggressive?", (3) "To what extent is this woman likely to have an existing criminal record?", (4) "How likely is it that she was arrested for a violent crime?", and (5) "Assuming her guilt, how likely is it that she will commit another crime?". The five questions have been clustered in one index '*perceived aggressiveness of the female*' (Cronbach's alpha = .82; .60 in the original study). The perceived guilt of the suspect was measured with one question: "How likely is it that she is guilty of the charge?". All answers may be entered on 7-point scales where 1 means *highly unlikely* and 7 means *highly likely* (Vrij, 1997).

Results

To test hypothesis 1, the Student's *t*-test was conducted with the colour of clothing (light or black) as a factor. The *t*-test showed significant effect only for the "perceived aggressiveness of suspect" ($t(142) = 2.7$, $p = .01$, $d = 0.45$). To test hypothesis 2, due to abnormal distribution, the Mann-Whitney *U* test was conducted. From this test, it can be concluded that there is no significant difference between black (mean rank = 76.64) and white group (mean rank = 68.36) for "perceived guilt" factor ($U = 2294$, $z = -1.22$, $p = .22$). The results are presented in Table 1.

Table 1

The Perceived Aggressiveness and Guilt of the Offender as a Function of Clothing (Light/Black)

	Colour of clothing				
	Black		Light		
	M	*SD*	*M*	*SD*	*p*
Perceived aggressiveness of the suspect	3.61	1.05	3.13	1.40	.01
Perceived guilt of the offender	3.87	1.28	3.56	1.07	.22

Taking into account the moderate result of Cronbach's alpha, we decided to check whether the individual questions making up the aggressiveness questionnaire also differentiate subjects. For this purpose, we compared the responses about the colour of clothing in terms of each of the questions, Table 2 presents the obtained results. Table 2 shows that all means are higher when the offender wore black clothing. The *t*-test showed significant effect for the "argumentativeness" ($t(142) = 2.16$, $p = .03$, $d = 0.36$), "aggressiveness" ($t(142) = 2.13$, $p = .03$, $d = 0.35$), "arrest for a violent crime" ($t(142) = 2.98$, $p = .00$, $d = 0.49$), but not for "existing criminal record" ($t(142) = 1.49$, $p = .13$, $d = 0.24$) and "committing another crime" ($t(142) = 1.52$, $p = .13$, $d = 0.25$).

Table 2

Comparison of Results of Separate Components of the 'Perception of Aggressiveness' Factor Depending on the Colour of Clothing (Black or White)

	Condition	*M*	*SD*	*t*	*p*	*d*
Perception of aggressiveness	White	3.13	1.05	2.7	.01	0.44
	Black	3.61	1.07			
Argumentativeness	White	3.38	1.28	2.16	.03	0.36
	Black	3.87	1.40			
Aggressiveness	White	3.08	1.43	2.13	.03	0.35
	Black	3.55	1.20			
Existing criminal record	White	2.69	1.28	1.49	.13	0.24
	Black	3.04	1.49			
Arrest for a violent crime	White	3.01	1.39	2.98	.00	0.49
	Black	3.70	1.38			
Committing another crime	White	3.50	1.57	1.52	.13	0.25
	Black	3.90	1.60			

Discussion

A replication of Aldert Vrij's (1997) study confirmed the influence of the stereotyped colour black on the creation of impressions. Similar conclusions were already presented in earlier studies (Frank & Gilovich, 1988). Empirical research confirms the perception of black with its symbolic meaning. As Cirlot (2006) writes, black is associated with disbelief, death, evil, or mourning. White, on the other hand, is identified with light, purity, and innocence. It is also associated with freedom, goodness, and truthfulness. This process of categorization saves cognitive resources. The results show that the suspect was perceived as more aggressive when she wore black clothing, which supports hypothesis 1. It is worth noting that the effect size was moderate (d = 0.45). This confirms the validity of the conclusion presented by Aldert Vrij, who wrote about the functioning of the black colour stereotype. However, there was no significant difference in perception of guilt depending on the colour of clothing, which did not support hypothesis 2 in contrast to the original study by Vrij (1997).

Given that our first study was designed to replicate earlier results, the goal was only partially achieved. Only the relationship between the colour of the clothes and aggressiveness was confirmed, but not the judgment of guilt. A possible cause could be the fact that in the case of the question about guilt, the respondents most often gave a middle answer on the Likert scale. The tendency to choose middle answers may be due to a desire to refuse to answer or to avoid discussion (Khorramdel & Davier, 2014). Perhaps the respondents, deprived of any other indications of possible guilt, signalled the refusal to assess the probability of something as serious as a conflict with the law based on the photo itself. This tendency may have been reinforced by not providing participants with details of the alleged crime. However, it should be underlined that this procedure was identical to that used by Vrij (1997). Taking into account the similarity of the procedure and the difference in the results, it can be assumed that it was the passage of time and the related social changes that may have contributed to avoiding formulating an unambiguous assessment of guilt. Perhaps people today are less inclined to form an opinion on factual questions, but there has been no analogous change in the context of opinion. This could result from the growing awareness that materials such as photos can be easily modified, and thus the mere fact of presenting someone in a photograph evoking associations with arrest does not have to be a sufficient basis for assessing the guilt of that person. If this reasoning were true, it would be expected that in the case of digital representations of people (such as the avatars used in Study 2), giving an unambiguous opinion should be even stronger avoided.

Our detailed analysis of the individual items in the Aggressiveness Impression Scale showed that only some of them revealed a statistically significant effect with moderate effect sizes (d = 0.35 - 0.49 in case of significant differences). This was the case for questions concerning: "argumentativeness" (p = .03), "aggressiveness" (p =

.03) and propensity to use violence (p = .00). A statistically insignificant effect appeared for the items on criminal history (p = .13) and risk of reoffending (p = .13). There may have been a floor effect for these questions due to the difficulty of assessing the suspect in terms of recidivism and criminal past. Undoubtedly, these items have a higher moral value than those on rowdiness, aggressiveness, or violence.

The question of the limits of the universality of this effect has still not been fully answered, because since Vrij's research, a new environment of social interaction – a virtual environment - has gained importance. Study 2 was devoted to this issue. Several studies have been conducted to see if this trend holds. Merola et al. (2006) showed that avatar colours influence behaviour in a virtual world. When participants were asked to discipline and designate an alleged offender, avatar users in black robes were more severe in their punishments than avatar users in white robes. The above results are consistent with the work of Peña et al. (2009), where dark-robed avatar users exhibited a priming effect for negative attitudes. This made them more likely to show aggressive intentions and behaviours than avatar users in light clothing. Other studies show that in virtual reality, avatars wearing black outfits are trusted less than avatars wearing white (Peña & Yoo, 2014). Ilie et al. (2008) examined whether colour bias can be transferred to the world of virtual competition. In their study, they referred to the findings of Hill and Barton (2005), who analysed data from the 2004 Olympic Games, where they concluded that opponents in red sportswear were more likely to win against those in blue. Ilie et al. (2008) compared the score of red and blue teams in a popular multiplayer first-person shooter (FPS) computer game. They collected data for 3 months from a publicly available global statistics server. Results from 1347 matches played by the top 10 players in the same virtual arena were included. Red teams won 54.9% of the matches, and this effect was highly significant. They conclude that joining the red team may give a slight advantage over the blue team in the virtual competition, which should be taken into account when designing FPS games. It is likely that "seeing red" may trigger a strong psychological distraction signal in human aggressive competition.

All of the above research may help us understand the relationship between clothes' colour and impression formation indirectly. But no research aimed to replicate the very first effect found by Vrij has been published yet. The progressive digitization of social life, including online lawsuits (Steubing, 2021), has become even more real in the face of the COVID-19 pandemic, and in the fall of 2021 Mark Zuckerberg (Facebook CEO) presented a demo of "Metaverse" - a virtual environment with ambitions to replace some direct contacts with avatars in the future (Takala, 2021). These two real-life reasons should be enough motivation to research this phenomenon in virtual environments. It was the goal of Study 2.

Study 2

Overview of the Study

Study 2 aims to test the influence of stereotype colour black on the creation of impressions in a virtual environment. It used a virtual environment defined as a system giving the interactive experience of the real world through a computer-generated reality (Schueffel, 2017). Objects in such a space convey perceptual information, often in multiple sensory modalities: visual auditory, tactile, and olfactory (Schueffel, 2017). According to the *Computers Are Social Actors Theory* (CASA; Nass & Moon, 2000), computers and computer agents may be treated according to the social rules, supposedly reserved only for human beings. The authors (Nass & Moon, 2000) state that people unreflectively apply social norms to computers. They argue that computers are perceived as similar to humans based on numerous empirical results regarding issues like Fogg and Nass (1997), Nass et al. (1995, 1996). For this reason, Study 2 used a virtual environment, assuming that a similar effect as in Study 1 should emerge. On the other hand, the failure of the replication of the effect regarding the assessment of the guilt of the person presented in the photo also requires taking into account the possibility that as a result of the growing level of digital literacy, people may not be inclined to apply stereotypes based on the external appearance other peoples' digital representations.

Based on the research and assumptions described above and considering our single result insufficient reason to speculate, the following hypotheses were formulated: H_1: A female represented by an avatar in black attire will be perceived as more aggressive than in white attire in a virtual environment. H_2: A female represented by an avatar in black attire will be more likely to be perceived as guilty of the alleged crime compared to one wearing white attire in a virtual environment.

Pilot Study

Before proceeding to proper examination, it was necessary to check the functioning of the procedure. The pilot study involved 10 people (7 women and 3 men). The age range of the respondents was 21-27 (M = 23.00, SD = 1.54). The participants were presented with a recorded clip in the appropriate colour version, and then responded to the Aggressive and Guilty Impression Scale. The pilot study met its objectives and allowed us to correct some details (avatar voice volume, view option, adding manipulation check, and improving a randomization method).

Method

Participants

The **main study** was conducted on a sample of 189 adults, of which 154 (81%) were women and 35 (19%) men. The age range of the subjects was 18-58 (M = 25.00, SD = 5.75). The subjects were invited to the study via Facebook and the procedure was conducted online. Before the study, a statistical power analysis was performed in G*Power (ver. 3.1.9.2; Faul et al., 2009) to estimate the sample size based on data from Vrij's (1997) study (N = 52). The effect size in this study (eta-squared = .08) is considered as a medium using Cohen's (1992) criteria. Assuming alpha = .05 and power = .80, the minimum sample size required for this effect size is N = 82. In our study, we doubled the sample size to N = 189, taking into account possible lower internal validity due to the use of a virtual environment and to allow for additional analysis of the moderating role of gender identification.

Materials

The movie. The participants were presented with a video (1 min 30 s) entitled "Self-presentation". It was recorded using the vTime application. In recent years it has also been used for research purposes to study the behaviour of its users in immersive virtual reality (Shriram & Schwartz, 2017). For our study, we created two avatars of women. Depending on the condition, the avatar had a white or black top, as shown in Figure 1 in Appendix.

In both cases a conference room environment was used, ambient sounds were muted, and the nickname "Presenter" was used. During the presentation, the avatar answered the questions: (1) What is your name? (2) How old are you? (3) Where are you from? (4) What are your parents' names? (5) do you have any siblings? (6) What do you like to do in your spare time? (7) What is your favourite sport? The content of the self-presentation was as follows: "My name is Aneta. I am 26 years old. I come from Radlin, a small town near Kielce. My parents' names are Krystyna and Stanislaw. I have two siblings: a sister and a brother. In my free time, I like mountain hiking very much. My favourite sport is cycling." The whole interaction in the virtual environment took 90 minutes.

Aggressiveness and Guilty Impression Scale. Study 2 used the same scale as Study 1. The impression of aggressiveness was measured by five questions. They were combined into a single indicator "impression of aggressiveness" (Cronbach's alpha = .81). The impression of guilt was measured by one question: "How likely is it that the woman is guilty of the charge?". Responses were given on a 7-point scale from (1) *highly unlikely* to (7) *highly likely*.

Manipulation Check. To check whether the subjects understood and followed the instructions, three additional questions were used. "What is the name of the

person with the nickname Presenter?", "What colour is the sofa on which the Presenter sits?", "What is the Presenter's favourite sport?". The questions were closed questions with three answers offered, one of which was correct. A minimum requirement of at least two correct answers was set. The results of three participants who did not meet this criterion were excluded from further analyses to minimize the risk of statistical inference based on an inefficient manipulation (Hauser et al., 2018).

Procedure

The procedure was similar to Study 1. Firstly, participants were randomly assigned to one of two colour conditions. The participants were given the information: "the person with the nickname Presenter, is suspected of committing a crime, her guilt has not yet been proven" The next step was to watch the video. Subsequently, respondents were asked to complete questions regarding the manipulation check, Impression if Aggressiveness, and Guilty Impression Scale.

Results

To test whether the colour of the avatar's T-shirt influences the evaluation of his aggressiveness, *t*-test was conducted. Based on the results presented in Table 3, it can be seen that the difference between perceiving aggression of the avatar in black attire (M = 3.00, SD = 0.98) and the avatar in white attire (M = 3.23, SD = 1.01) was not statistically significant. ($t(184) = 1.53$; $p = .12$; $d = 0.23$).

To check whether a female avatar in black attire will be more likely to be found guilty of the alleged crime compared to a white avatar, U test was used due to the results' abnormal distribution. Table 3 also shows the averages in guilt ratings. The difference between perceived guilty of the avatar in white attire (M = 3.31, SD = 1.20) and the avatar in black attire (M = 3.17, SD = 1.32) was not statistically significant (U = 3966.50; z = -1.00; p = .31).

Table 3

The Impression of Aggression and Guilt of the Offender as a Function of Clothing (Light/Black)

	Colour of clothing				
	Black		Light		
	M	*SD*	*M*	*SD*	*p*
Impression of aggressiveness of the female suspect	3.00	0.98	3.23	1.01	.12
Impression of guilt of the offender	3.17	1.32	3.31	1.20	.31

Consistently with Study 1, we decided to carry out a thorough analysis of the results for each of the five questions included in it. The results in Table 4 show that the only question that revealed statistically significant differences in means is

argumentativeness. Avatar in white costume was rated higher (M = 3.48, SD = 1.17) in terms of argumentativeness than the avatar in a black T-shirt (M = 3.10, SD = 1.19) ($t(184) = 2.18$; $p = .03$; $d = 0.32$).

Table 4

Student t- Test for Independent Samples with Means, Standard Deviation, Significance Level, and Cohen's d for the Aggressiveness Scale and its Component Questions

	Condition	*M*	*SD*	*t*	*p*	*d*
Perception of aggressiveness	White	3.23	1.01	1.53	.12	0.23
	Black	3.00	0.98			
Argumentativeness	White	3.48	1.17	2.18	.03	0.32
	Black	3.10	1.19			
Aggressiveness	White	3.18	1.28	1.92	.05	0.28
	Black	2.81	1.31			
Existing criminal record	White	2.90	1.33	1.33	.18	1.74
	Black	2.63	1.35			
Arrest for a violent crime	White	2.72	1.22	0.88	.38	0.12
	Black	2.56	1.29			
Committing another crime	White	3.90	1.48	-0.22	.82	0.02
	Black	3.94	1.52			

Discussion

Study 2 was designed to see if the stereotype of the colour black would also occur in a virtual environment. Its results showed that both hypotheses, regarding the perceived aggressiveness and guilt of a woman represented by an avatar in black or white attire, were false. It is worth noting that Study 1, in which subjects were presented with a photograph of a real woman, provided support for hypothesis 1, but not hypothesis 2.

The obtained results call into question the reasoning based on the theory of Nass and Moon (2000). It was based on the assumption that since people treat computers as social actors, which is manifested in the application of social norms and stereotypes to them, the real-world result of the influence of clothing colour on the assessment should be possible to demonstrate using the VR medium. Although in Study 1 we were able to confirm the existence of the effect identified by Vrij (1997) in terms of trait evaluation, a similar effect did not exist in VR. The obtained result may be an indication of the limits of applicability of this theory in the context of digital representations of people. The original theory was formulated strictly with computers in mind, but over time it has been extended to a variety of "computer-related characters" such as chatbots (Liu & Sundar, 2018) or even trackers (e.g. pedometer in the study of Hancı et al., 2019). Perhaps the study participants applied a "correction" resulting from their previous experience with electronic media, which

in no way guarantees that the avatar's features reflect the user's features. This leads to an unanswered question - do computer-controlled devices and agents have a greater potential to be "social actors" compared to the actual people behind digital representations? This question needs further investigation.

General Discussion

The research presented here aimed to see the impact the colour of clothing has on forming impressions. The studies differ in ways of exposition on the subject: (1) photography of a human and (2) recording of an avatar in a virtual environment. Hypothesis 1 was partially confirmed (only in a real environment). Hypothesis 2 was not confirmed.

Experiment 1 confirmed hypothesis 1 which stated that the person dressed in black clothing would be perceived as more aggressive than the same person dressed in white clothing. Similar results were presented in the study by Vrij (1997) which was the inspiration for this one. Another study with similar results was one by Frank and Gilovich (1988) which showed that the people in black clothing (compared to those in white) are judged more critically and extremely. This is consistent with the general finding that clothing influences opinion formation about the person wearing it (Buckley & Roach, 1974; Conner et al., 1975; Paek, 1986), but only when the observer is not familiar with the person being evaluated (Hoult, 1954).

The results of our and previous research can be linked to the relations between the colour black and its symbolic meaning. Black is most often associated with negative traits (Cirlot, 2006; Mucha, 2014). White colour, which is compared to black in empirical studies, means light, innocence, purity, goodness, sincerity, or freedom. Popular connotations of certain colours can impact the process of creating impressions and opinions.

Detailed analysis of every factor in the Aggressiveness Impression Scale in experiment 1 shows that the person in black clothing is rated higher (on statistically significant level $\alpha < .05$) than the person wearing white, in terms of "argumentativeness", "physical aggressiveness", "existing criminal record". Effect size in those positions is classified as moderate to high (Cohen, 1992), whereas in the original experiment by Vrij (1997) the effect sizes were smaller. That shows that the stereotype of black colour is still functioning. Results of those experiments give important implications, especially for people with jobs relating to the process of creating impressions, like policemen, judges, or experts.

Despite promising premises, hypothesis 2 about people dressed in black being more often judged as guilty if suspected of committing a crime wasn't confirmed in experiment 1, as well as experiment 2. It can be linked to the fact that subjects were often choosing the middle answer on the Likert's scale in question about guilt and the tendency to choose middle answers may be due to a desire to refuse to answer or

to avoid expressing their own opinion (Khorramdel & Davier, 2014). Questions regarding guilt have greater moral value than questions about aggressiveness. For this reason, it may be difficult to give a clear assessment.

While Study 1 was able to replicate Vrij's results, Study 2, conducted in an identical paradigm but a virtual environment, did not. As Frank and Gilovich (1988) conclude, the black colour of an outfit affects negative evaluation, but only in the context of competition, confrontation, or physical aggression. The subjects in experiment 2, like the subjects in Study 1, received the same information about the alleged crime of the person about to be presented to them. The conflicting results in the two studies conducted can be explained by the context of the entire presentation. In Study 1, a woman was shown in a photograph against a backdrop of stripes, holding a name tag in her hands, which mimicked the moment of arrest in police custody. In contrast, in Study 2, the suspect was presented with a background of books, sitting on a red sofa (Figure 1). Such an environment may have been reminiscent of a library, and therefore more of a scholarly environment than a criminal one. For this reason, subjects may have felt uncomfortable tension due to cognitive dissonance (Festinger & Carlsmith, 1959) and as a result, their ratings could be centered.

Consistent with CASA research presented previously (Nass & Moon, 2000), it was predicted that the black colour effect would occur in virtual environments, given that people apply social norms to the computer similarly to humans. However, as indicated by research (Bubser, 2019; Bystrom et al., 1999; Strojny et al., 2020) in virtual environments, the level of realism, which is defined as the way people, things, and situations are represented according to the reality of everyday life, is very significant. Perhaps, the female avatar created using the vTime application was not perceived as a real partner. For this reason, the subjects may not have applied the social norms they apply to people to it (Study 1). As we discussed above, it is also possible that CASA predictions regarding computers and computer agents do not always apply to humans' digital representations.

It is worth noting that an item-by-item analysis of the Aggressiveness Impression Scale showed that the item on "argumentativeness" produced a statistically significant effect, however, the opposite of the predicted effect. The subjects rated higher the argumentativeness of the avatar in white attire than in black attire. This phenomenon is interesting and has many possible justifications. This may be related to the way the suspect is presented (using an avatar in a virtual environment). The process of impression formation may be different in the new technology world than in the real world, as shown by the opposite results in Studies 1 and 2. In a virtual environment, one's image is also created, e.g. by choosing characteristic features of an avatar. Trusewicz-Pasikowska (2018) writes about the so-called virtual identity, which is the virtual counterpart of imaginings, dreams, or unattainable aspirations concerning one's person. Perhaps the subjects evaluated the

female avatar in the white outfit more negatively, suspecting that it hides a person with aggressive traits. Such conjectures require further exploration.

Limitations and Strengths

Some potential limitations of the present study should also be taken into account. The first is that the two studies differ in how they are conducted. Study 1 was conducted in the lab and each person was surveyed separately. Moreover, we did not control the variables related to the individual perception of the meaning of colours (e.g., rock music subculture). In this case, the subject may have had a different cognitive representation of the person wearing black. In the modified replication, we can point out the following differences: the photo used for our study was developed from the description, it was not the original photo used in Vrij's study; the study group in the modified replication was significantly larger than in the original study; the equality of men and women in both groups was preserved, while in the Vrij study we have no information on this issue. Experiment 2 was conducted online with a different way of a suspect presentation (3D model). Due to the online format, multiple participants were able to take part in the study at the same time without interrupting each other, the online form also has its limitations, such as the inability to fully control the course of the experiment. There is no assurance that all participants followed the instructions and viewed the entire presentation of the female avatar, to minimize this risk we used a manipulation check. They also may not have read the information about her alleged crime.

Although Study 1 was conducted in the real environment, it is worth noting that it is also not free of limitations. The fact that each person was examined individually and in person may have affected the course and results of the study. Another potential limitation is a homogeneous research sample. Study 1 was conducted on a sample of students aged 18-25. For this reason, the sample may not have been representative. In contrast, in Study 2, participants were from different age groups (18-58).

Another limitation is the potentially imperfect tool used in both studies - the Aggressiveness and Guilt Impression Scale. It should be noted that this is the questionnaire by Vrij (1997). Statistical analysis shows that this tool achieved acceptable internal reliability in both experiments. Given the continuation of the research initiated by Vrij, the choice of the author's tool, despite its imperfections, should be considered valid.

Undoubtedly, a strength of both studies was the size of the research sample, which was 144 participants in Study 1 and 189 in Study 2. It is worth noting that the publication by Vrij (1997) described an experiment conducted on a sample of 52 people.

The results obtained in the conducted research are an extension of the current research on the colour of clothing and its influence on cognition. The topic should certainly be explored because the attempts to explain a given phenomenon made in

this paper are not definite. An interesting direction that needs further exploration is gender differences in the perception of clothing colours. A further direction for the research described above could be to refine the situational context in which the person being assessed is placed. Since the limitation of Study 1 and 2 was the different backgrounds of the depicted woman in the photo or avatar during the recording, the new Study could unify it. Additional manipulation of the environment would be interesting. Another suggestion may be to expand the area of making judgments and forming impressions. The above studies only took into account the context of the crime and the aggressiveness and guilt being assessed. Another direction would be to investigate how colours of clothes influence, for example, the assessment of personality traits, character, temperament, competence, etc. Certainly, further research in this area will yield interesting conclusions, which would help in understanding the phenomenon of social cognition.

Conclusion

The colour of clothes is an interesting factor influencing peoples' social assessments. Because in virtual reality one of the most popular parameters that can be modified is the colour of clothes, we found a question about the influence of the colour of the avatar's clothes on their controllers' perception interesting. Despite the promising premises Study 1 showed a significant effect for only the perceived aggressiveness of the suspect. It can be concluded that there is no significant difference between the black and white groups for the "perceived guilt" factor. Results of Study 2 showed that both hypotheses, regarding the perceived aggressiveness and guilt of a woman represented by an avatar in black or white attire, were false. Although in Study 1 we were able to confirm the existence of the effect identified by Vrij (1997) in terms of trait evaluation, a similar effect did not exist in VR.

The results obtained in this study are an extension of the current research on clothing colour and its influence on cognition, which was initiated by Vrij (1997). The topic should certainly be deepened, as the attempts to explain the phenomenon in question in this study are not exhaustive. An interesting direction that needs further exploration is gender differences in the perception of clothing colours. The idea could be to explore gender differences as a research model that would use photographs of both women and men in different colour variations of clothing. A review of research on the influence of colour on impression formation shows that researchers mainly focus on the evaluation of women (Vrij, 1997; Vrij & Akehurst, 1996) or men (Frank & Gilovich, 1988; Johnson, 2005).

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Appendix

Figure 1

Example Screenshots in the Condition with White and Black Colour Versions