Title: Investigating the effect of trustworthiness on instruction-based reflexivity

Authors: Van der Biest Mathias*, Cracco Emiel*, Wisniewski David, Brass Marcel, González-García Carlos

*Van der Biest Mathias and Cracco Emiel are both first authors

Department of Experimental Psychology, Ghent University, Belgium
Ghent University
Faculty of Psychology and Educational Sciences
Department of Experimental Psychology
Henri Dunantlaan 2
B-9000 Gent

Corresponding author: Mathias Van der Biest (mathias.vanderbiest@ugent.be)
Declaration of interests: none

Abstract

Unlike other species, humans are capable of rapidly learning new behavior from a single instruction. While previous research focused on the cognitive processes underlying the rapid, automatic implementation of instructions, the fundamentally social nature of instruction following has remained largely unexplored. Here, we investigated whether instructor trustworthiness modulates instruction implementation using both explicit and reflexive measures. In a first preregistered study, we validated a new paradigm to manipulate the perceived trustworthiness of two different avatars and showed that such a manipulation reliably induced implicit associations between avatars and trustworthiness attributes. Moreover, we show that trustworthy instructors are followed more frequently and faster. In two additional preregistered experiments, we tested if trustworthiness towards the instructor influenced the cognitive processes underlying instruction implementation. While we show that verbally conveyed instructions led to automatic instruction implementation, this effect was not modulated by the trustworthiness of the instructor.

Keywords: Trustworthiness, instruction-based reflexivity, social cognition, instructions, cognitive control

Introduction

The human capacity to learn new behaviors, rules, and actions based on instructions is a unique skill that separates human cognition from that of other species (Cole, Laurent, & Stocco, 2013). This rapid transformation of the declarative content of the instruction into a meaningful action-oriented format, capable of driving the instructed behavior, occurs already after a single presentation, even before its first execution. In contrast, it takes non-human primates months to learn simple, repetitive match-to-sample tasks or set-shifting tasks (Nakahara, 2002; Verrico et al., 2011). Instruction following is thus a key human skill we use daily, such as when constructing furniture from a manual, using new technology, or following directions. As such, instruction following and implementation is considered a central pillar of human collaborative behavior and crucial for human cultural evolution (Heyes, 2018).

Recently, cognitive neuroscientists have started to characterize an intriguing form of instruction following, namely rapid instructed task learning (Brass, Liefooghe, Braem, & De Houwer, 2017; Cole, Bagic, Kass, & Schneider, 2010; Cole et al., 2013; Meiran, Pereg, Kessler, Cole, & Braver, 2015). This type of instruction following reflects the fast (i.e., single trial) understanding and flexible implementation of novel instructions that leads to a phenomenon called "instruction-based reflexivity" (IBR) (e.g. Liefooghe, De Houwer, & Wenke, 2013; Liefooghe, Wenke, & De Houwer, 2012; Meiran et al., 2015). IBR refers to the reflexive activation of instructed actions, irrespective of task relevance and action familiarity (Liefooghe et al., 2013). For example, behavioral studies demonstrated with different experimental paradigms that instructions can interfere with irrelevant ongoing task behavior (Liefooghe, Demanet, & Vandierendonck, 2010; Meiran, Liefooghe, & De Houwer, 2017). Crucially, however, a necessary condition to observe IBR is that the instructions are transformed from a declarative (i.e., semantic) to a procedural (i.e., action-oriented) format, by forming the intention to implement the instructions (Liefooghe et al., 2013; Wenke, Gaschler, Nattkemper, & Frensch, 2009). This dissociation between declarative and procedural representations of instructions is also supported by brain imaging (González-García, Arco, Palenciano, Ramírez, & Ruz, 2017; González-García, Formica, Liefooghe, & Brass, 2020; Muhle-Karbe, Duncan, De Baene, Mitchell, & Brass, 2016).

Even though the IBR is a reflexive effect, it can still be modulated. For example, increasing workload diminishes the IBR effect (Meiran & Cohen-Kdoshay, 2012), while decreasing the response deadline and hence modulating the difficulty-context results in an increased IBR effect instead (Liefooghe et al., 2013). While, increasing the likelihood of implementing the instruction (i.e., the frequency of prospective use), an increased IBR effect was found (Whitehead & Egner, 2018). This demonstrates that automatic instruction implementation is affected by other cognitive processes. However, such an approach is agnostic regarding the fundamentally social nature of instruction-following. That is, we mostly receive instructions either directly from someone, for example, a police officer redirecting traffic, a pilot getting instructions from the traffic tower, a teacher in front of a class, or indirectly, from tutorial videos, an instruction manual, or even helpdesk bots. This social dimension of instruction following has important implications, as it suggests that IBR may be sensitive not only to cognitive but also to social variables. In line with this view, it has been demonstrated in social psychology that the social traits of our interaction partners can modulate our behavior. For example, trustworthiness has been shown to influence helping behavior (Wang, Wang, Han, Liu, & Zhang, 2018) and credibility (McGinnies & Ward, 1980). Similar social variables have further been shown to affect high-level cognitive (Baarendse, Counotte, O'Donnell, & Vanderschuren,2013) as well as motor functions (Cracco, Genschow, Radkova, & Brass, 2018). Concerning instruction following, Hale, Payne, Taylor, Paoletti, and Hamilton (2018) recently demonstrated the influence of instructor trustworthiness on decision-making processes and *explicit instruction* following in a virtual reality maze study. They manipulated the trustworthiness of two avatars during an interview. Afterwards, participants escaped from a virtual maze and could ask direction advice from one of the two avatars. Participants approached the trustworthy avatar significantly more often and followed their advice more often compared to the advice of the untrustworthy avatar. This evidence suggests that social variables affect the explicit implementation of instructions. Crucially, however, whether social variables such as instructor's trustworthiness also modulate the reflexive effect of instruction implementation remains unknown.

Given the extensive evidence for IBR and the fact that this effect can be modulated in principle, here we investigate whether social variables affect the automatic effects of instruction implementation, treating instructions as inherently social. More specifically, we investigated how the automatic IBR is modulated by the trustworthiness of the instructor. In a first experiment, we developed a novel paradigm to experimentally manipulate perceived trustworthiness (The Door Game) and validated the procedure using both implicit and explicit measurements. In two additional experiments, we tested the influence of trustworthiness, as manipulated by The Door Game, on instruction following, as measured using the IBR paradigm (Liefooghe et al., 2012). In order to do so, we developed a 'social' version of the IBR paradigm where an avatar instructs participants to carry out specific S-R mappings. We hypothesized a reduced IBR for untrustworthy compared to trustworthy instructors.

Experiment 1

Method

Participants. 49 first-year psychology students (36 female, M_{age} =19.65 years, SD_{age} = 2.26, all naïve to the purpose of the experiment) at Ghent University participated in the experiment in return for one course credit and monetary reimbursement up to 2.30 euro. The experiment was conducted in accordance with the local institutional ethics committee, and all participants gave written informed consent. This study was preregistered (https://aspredicted.org/blind.php?x=f8wr7a).

Apparatus. The experiment was programmed in Psychopy (Peirce, 2019), and all the instructions were presented on a black background with a white font. Participants were tested on a 15-inch Dell computer monitor with corresponding Sennheiser 215 headphones.

Trust Manipulation. To manipulate the trustworthiness of the instructor, a new social manipulation was designed based on a simple game. Participants received advice from one of two different human-like digital avatars to choose one out of three doors (e.g., "I would pick the red door"). The verbal instructions were recorded by two native Dutch speakers and were synchronized with the lip movements of two different virtual avatars, created with the software CrazyTalk. As a result, we obtained four instructors, based on two voices and two avatars, named Lulu, Soni, Paola, and Cati. For each participant, two different avatars with different voices were randomly selected. After hearing the advice, participants had to select one out of three doors (i.e., Red, Blue, Green) by pressing the corresponding numeric keyboard button (i.e., "1", "2","3"). Participants were instructed that they could freely choose to follow the advice or not and had up to five seconds to decide. One door led to winning 0.10 Eurocent, another to losing 0.10 Eurocent, and a third door did not lead to any reward or punishment.

Participants received feedback by means of a green circle (winning 0.10), red circle (losing 0.10), or white circle (no reward nor punishment). Moreover, the amount of money earned was updated and displayed on a corner of the screen during the entire game.

One of the avatars consistently advised picking the door leading to monetary reward (i.e., trustworthy avatar) while the other avatar (i.e., untrustworthy avatar) gave good, bad, or neutral advice in 33% of the trials each. Crucially, the participant was not informed about this difference and learned this trustworthiness distinction within 36 trials (see Figure 1).

Implicit Association Test. To measure trustworthiness, we tested if the trustworthy and untrustworthy avatars were implicitly associated with trustworthy and untrustworthy attributes, using an Implicit Association Test (Greenwald, Nosek, Banaji & 2003). This paradigm consisted of five blocks, in which the participant had to respond with left-right keyboard responses (.i.e., "I or E" keys) to categorize different stimuli (e.g. either avatar, trustworthiness attributes, or both). In the first block, the avatars were associated with a specific response (e.g. "*if you see a picture of Paola press I*", "*if you see a picture of Cati press E*"). In the second block, trustworthy and untrustworthy attributes were associated with a specific response (e.g. "*if you see a word associated with trustworthiness, press I*", "*if you see a word associated with untrustworthiness, press E*"). These associations were practiced in blocks one and two, where only one stimulus type was presented (i.e., avatars in block 1, and (un)trustworthy attributes in block 2). In the third block, both avatars and attributes were presented intermixed, and categorized according to the stimulus-response mappings learned in the previous blocks.

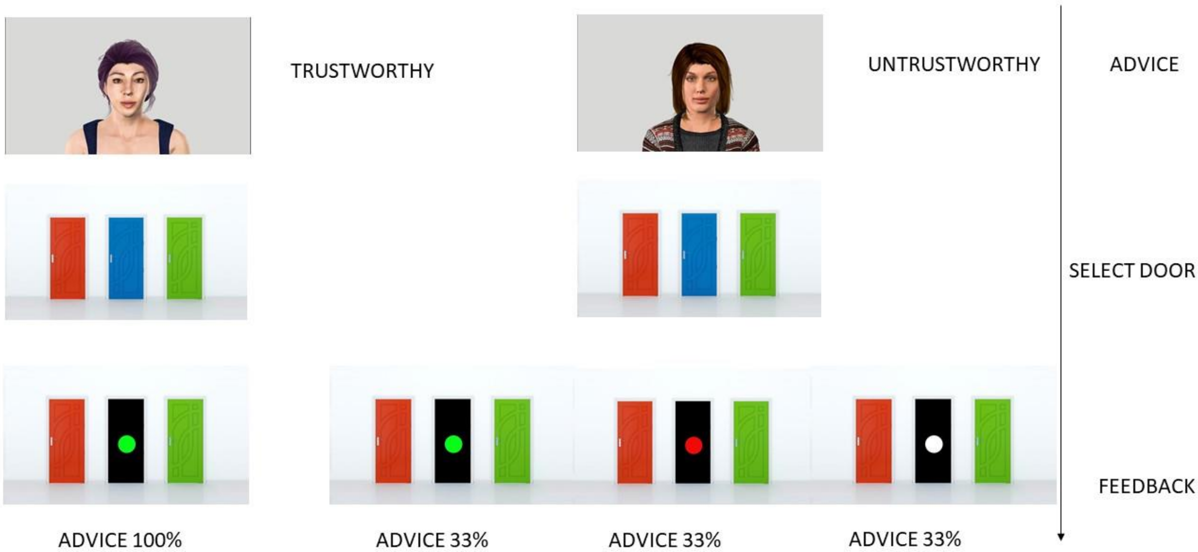

Figure 1. The design of The Door Game. The arrow depicts the timeline. During the advice phase, either a trustworthy or an untrustworthy avatar gives their preference for a door, in this example "I would pick the blue door". Next, the participant had to select a door by pressing a corresponding keyboard key (e.g. "1" = red, "2" = blue, "3" = green). When the avatar is trustworthy, unbeknownst to the participant, following the advice always leads to an optimal monetary reward (green circle). When the avatar is untrustworthy, following the advice leads to a monetary reward, a punishment (red circle), or no reward nor punishment (white circle) in 33% of the trials each.

Following, was a fourth block in which the response mapping for the trustworthiness attributes was reversed and like block two only one stimulus type (i.e., trustworthiness attributes) was presented (e.g. "Trustworthy press E", "Untrustworthy press I"). The last block was identical to the third block, but with the response, mapping practiced in the fourth block.

Procedure. The overall structure of the experiment was presented to participants prior to participating. First, participants played The Door Game for 36 trials. On 50% of the trials, the trustworthy avatar gave her advice for a door, whereas the untrustworthy avatar gave advice in the remaining trials. The trustworthiness of the avatar and voices were counterbalanced across participants but remained constant within one participant. Trial order was randomized. After selecting the preferred door, participants received feedback by means of a green circle (+10 cent) if the correct door was selected, or a red (-10 cent) or white (0) circle, if an incorrect door was selected, staying on display for 1 second. The total amount of money that had already been earned was always shown in the upper right corner. All participants started with one Euro.

Following this trustworthiness manipulation, the existence of an association between the avatar and trustworthiness was tested implicitly with the Implicit Association Test (Greenwald et al., 2003). The first, second, and fourth block consisted of 40 trials, in which the participant had to respond to either avatars (i.e., block 1) or (un)trustworthy words (i.e., block 2 and 4), with the corresponding response (e.g. "I" or "E"). The third and the last block consisted of 60 trials, with intermixed trustworthiness attributes and avatars. Participants were instructed to respond as fast as possible. If an error was made, a red fixation cross was presented beneath the stimuli, and the next trial would start after 150 ms when pressing the correct response.

Design. The independent variable for this within-subject design was instructor trustworthiness (e.g., trustworthy or untrustworthy). The explicit dependent variables were following rate, reaction times, and money earned during The Door Game. The dependent variable of the Implicit Association Test was "D1". D1 reflects the difference in reaction time for congruent and incongruent blocks during the Implicit Association Task (Greenwald et al., 2003).

Analyses

All analyses were conducted in Rstudio (RSTUDIO, version 3.4.3, 2017), in combination with JASP (JASP Team, 2018).

Door Game. To examine if the trustworthiness manipulation worked, we investigated if participants followed the advice of the trustworthy avatar more compared to the untrustworthy avatar by comparing the proportion of advice following for the trustworthy and untrustworthy avatar using a paired t-test. In addition to the preregistered analysis, a paired t-test was conducted to compare the reaction times of door selection following the advice of the trustworthy and untrustworthy instructors.

Implicit Association Test. Prior to the analysis, trials in which participants were slower than 10000 ms were excluded. Furthermore, we excluded participants who made over 40% of mistakes. To analyze the implicit association between the trustworthiness of the avatar and words associated with (un)trustworthiness, a D1 score was calculated following the standard guidelines (Greenwald et al., 2003). A two-sided one-sample t-test to compare D1 scores to zero was conducted. Values significantly above zero refer to faster responding on blocks where response mappings are shared between trustworthy avatars and positive trust-related words, and between untrustworthy avatars and negative trust-related words. Negative values reflect faster responding when the mappings are shared between trustworthy avatars and negative trust-related words, and between untrustworthy avatars and positive trust-related words. Furthermore, a Pearson correlation between the amount of earned money and the implicit bias was calculated.

Results

Door Game. A two-sided paired t-test revealed that participants followed the trust-worthy avatar (M_{follow} = .83, SD_{follow} = .22, SE_{follow} = .03) significantly more often than the un-trustworthy avatar (M_{follow} = .33, SD_{follow} = .10, SE_{follow} = .01), $t(48) = 13.58$, $p < .001$, d =1.94, and responded significantly faster after trustworthy (M_{RT} = 1106 ms, SD_{RT} = 667, SE_{RT} = 95) compared to untrustworthy avatar advice (M_{RT} = 1444 ms, SD_{RT} = 880, SE_{RT} = 126) trials, $t(48)$ = -4.39, $p < .001$, d = - .63.

Implicit Association Test. A two-sided one-sample t-test to compare the D1 score (M_{D1} = .31, SD_{D1} = .32, SE_{D1} = .05) to zero showed that the D1 scores were significantly larger than zero, $t(48) = 6.75$, $p < .001$, $d = .96$. Moreover, we observed a positive correlation between the amount of earned money during the game and D1, $r = .36$, $p < .01$.

Discussion Experiment 1

The results of the first study demonstrate the effectiveness of The Door Game to manipulate the trustworthiness of avatars/instructors, as shown both on explicit and implicit measures. Participants were capable to learn the trustworthiness of an avatar without prior information within 36 trials, as they significantly followed the trustworthy avatar more and responded faster to her advice, compared to the untrustworthy avatar. In addition to these measures, the result of the Implicit Association Test suggested that participants associated trustworthy avatars with trust-related attributes and untrustworthy avatars with an untrust-related ones. Moreover, the amount of earned money was positively correlated with this implicit bias, suggesting that participants with stronger implicit associations between the avatars and trust adapted their behavior more strongly to the avatars' trustworthiness during The Door Game. Overall, Experiment 1 thus validates a new and easy task to manipulate a complex social factor such as trustworthiness (Ashraf, Bohnet & Piankov, 2006). In the second experiment, we investigated the influence of trustworthiness on instruction implementation.

Experiment 2

Method

Participants. A group of 119 first-year psychology students (105, female, M_{age} = 19.43 years, SD_{age} = 4.35, all naïve to the purpose of the experiment) at Ghent University participated in the experiment in return for one course credit and a performance-based reward (up to 3.30

euro). An a priori power analysis indicated that in order to detect a small effect (d = 0.3) reliably ($\alpha = 0.05$, power = .90) using within-subject manipulations, we needed a sample size of *N* = 119. 21 participants were excluded from the analyses based on preregistered exclusion criteria (https://aspredicted.org/blind.php?x=ss8fx3), namely excessive errors (*N* = 5), responsiveness to the trustworthiness manipulation as measured by two Likert scales (*N* = 14), or both (*N* = 2). Note that due to the ambiguity of responses on the preregistered open questions (see APPENDIX A), a trustworthiness index was calculated. This reflects the difference between the ratings for the trustworthy avatar and untrustworthy avatar on a Likert scale from 1 (i.e., highly untrustworthy) to 5 (i.e., Highly trustworthy). When negative or zero the participant was excluded. The experiment was conducted in accordance with the local institutional ethics committee, and all participants gave written informed consent.

Materials and design.

Door Game. The materials of The Door Game were identical to the first experiment. However, now The Door Game was played for six blocks. The first block included 36 trials, whereas the remaining blocks had 12 trials each.

IBR. The IBR paradigm consisted of two tasks, an inducer task, and a diagnostic task. For the former, the participant was presented a S-R mapping (e.g. "*press left if the word is NEWS, press right if the word is BIKE*"). This rule must be retained until the participant was presented one of the two objects (e.g. "NEWS") in a colored print (e.g. "green"). Between the inducer screen and target, participants were shown a diagnostic task. During diagnostic trials, participants had to respond to a different dimension of the instructed stimuli, namely font (e.g. "*press left when the word is in italics, press right when the word is printed upright*"), independent of the previously instructed inducer task. The instructions for the diagnostic task remained identical over the experiment. Such task configuration lead to situations in which the required response by the diagnostic task overlapped with the instructed inducer response, and in which the correct response for the diagnostic runs were either compatible (e.g." Italics, NEWS"), or incompatible (e.g. "Upright, NEWS") (see Figure 2).

A list of 43 rules consisting of two Dutch words with a similar word frequency and a length of four letters was constructed (e.g. "*NEWS-BIKE*"), and participants were divided according to their participant number in two groups with opposite S-R mappings (e.g. *"If the* *word is NEWS press Left, if the word is BIKE press right", or "If the word is BIKE press left, if the word is NEWS press right").*The left-right keyboard response configuration responses ("D" and "K" on a QWERTY keyboard) were identical during diagnostic and inducer runs. Furthermore, the same pair of stimuli were presented for both tasks (see Supplementary Material Virtual Avatar for all stimuli for experiment 1,2,3).

The instructions of the IBR were presented by means of the same avatars as in The Door Game. Note that for each participant the avatars and voice configuration were identical in The Door Game and the IBR task. These spoken S-R mappings were randomly assigned to five blocks in groups of eight S-R mappings and one practice block which always consisted of the same two rules (i.e., *"if VOICE press left, if END press right", "if ADVICE press left, if LADY press right"*, or vice versa). Within each block, the S-R mappings were randomly paired with a specific number of diagnostic tasks runs (two runs with four diagnostic trials, two runs with eight diagnostic trials, two runs with 12 diagnostic trials, two runs with 16 diagnostic trials). These randomized lengths of runs made the appearance of the inducer task less predictable (Meiran et al., 2015).

Design. A 2x2 within-subject design with trustworthiness (e.g. trustworthy or untrust-worthy) and compatibility (e.g. compatible or incompatible) as independent variables was used. The crucial dependent variables were reaction times, error rates, and inverse efficiency scores (i.e., RT/1-Error Rates) ("IES") on the diagnostic trials during the IBR task.

Materials. The experiment was programmed in Psychopy (Peirce, 2019), and all stimuli of the diagnostic task were presented in white font on a black background. The inducers probes were printed in green. Further, participants were tested on a 15-inch dell computer monitor with corresponding Sennheiser 215 headphones.

Procedure. Participants were tested in groups of a maximum of five. Prior to their participation, participants were informed about the overall structure of the experiment (i.e., The Door Game and IBR paradigm). The experiment started with a block of The Door Game, consisting of 36 trials (50% trustworthy avatars, 50% untrustworthy avatars), followed by two practice trials of the IBR task and a new block of The Door Game, consisting of 12 trials (50% trustworthy avatars, 50 % untrustworthy avatars). This was then followed by an alternating sequence of IBR and Door Game blocks. Between each block, the instructions of either the IBR or The Door Game were repeated, and participants had the chance to take a break for as long as needed. Each run in the IBR blocks started with a video of an avatar (50% trustworthy avatar, 50% untrustworthy avatar), verbally instructing new S-R mappings for the inducer task. Note that these S-R mappings were only instructed by means of videos and were not visually presented. After the video, a fixation cross was presented for 500 milliseconds, and the diagnostic runs started. Each diagnostic trial was presented until a response was made or after 2000 ms had passed. When an incorrect response was given, participants received a red square as feedback. Following a full diagnostic run, a green fixation cross was presented for 500 ms, and the inducer probe was presented. Identical to the diagnostic trials, the probe inducer was presented for 2000 ms or until a response was made. Note, that no feedback was presented after the inducer task. After 500 ms a new video and corresponding diagnostic and inducer trials started. When the experimental phase was completed, participants filled in two short questionnaires on the computer, and one written questionnaire. The first questionnaire was the short Right-Wing Authoritarianism scale, which consisted of 14 Dutch items and was based on Altemeyer (1998). This questionnaire was included only for exploratory purposes and will not be reported. Next, participants were shown the two avatars and asked to rate their trustworthiness on a scale from 1 (e.g. *"very untrustworthy")* to 5 (e.g. *"very trustworthy"*). Finally, participants answered two questions about The Door Game (see APPENDIX A).

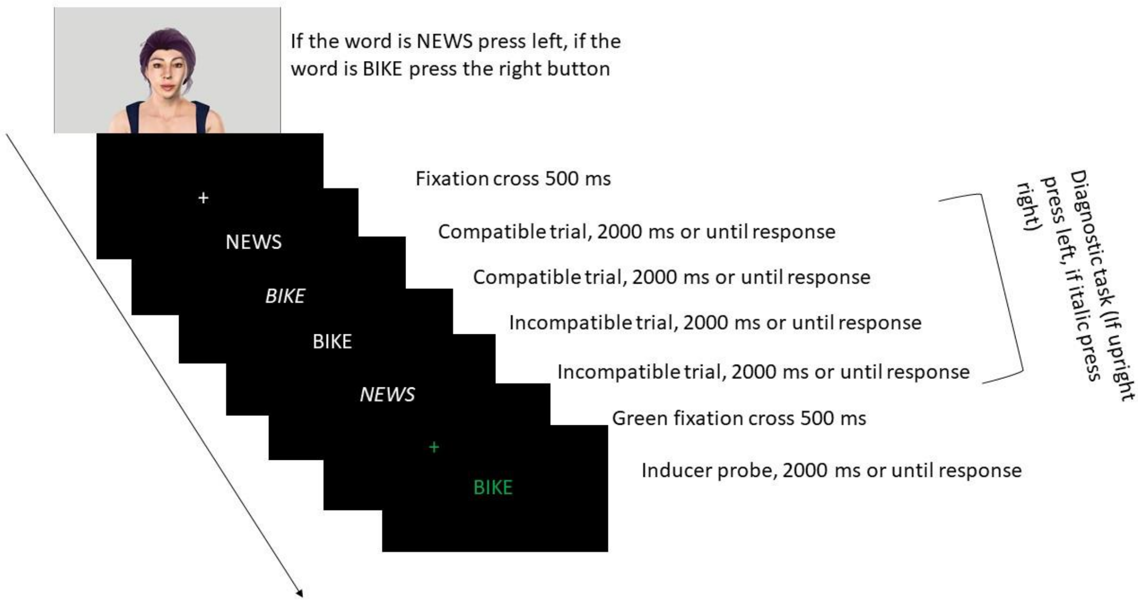

Figure 2. Example of the Instruction based reflexivity task. The black arrow depicts the timeline. First, the trustworthy or the untrustworthy avatar gives an S-R instruction (e.g. *"if the word is NEWS press Left If the word is BIKE press the right")*. Following is a white fixation cross for 500 ms, which is the start of the diagnostic runs. For this example, the diagnostic run consists of four trials, but this could also be 8, 12, or 16 trials. On each trial, one of the two S-R mappings were presented in italics (i.e., press right) or upright (i.e., press left). These trials can either compatible (e.g. first two trials) or incompatible (e.g. last two trials) with the instructed S-R mapping. The green fixation cross indicates the end of the diagnostic runs and prepares the participant for the inducer probe. Which is one of the two S-R mappings printed in green.

Analyses

All analyses were conducted in Rstudio (RSTUDIO, version 3.4.3, 2017), in combination with JASP (JASP Team, 2018).

Preprocessing. Prior to analysis, a trustworthiness index was calculated (i.e., trustworthiness rating trustworthy avatar minus trustworthiness rating untrustworthy avatar). If this score was zero or negative, the participant was excluded from further analyses. Additionally, the preregistered exclusion criteria were applied to the dataset. All participants that responded incorrectly on ≥ 40% of the diagnostic or inducer trials were excluded. At the trial level, all diagnostic trials following an error (9%) or with a response time faster than 200 ms (<.001%), and all diagnostic trials with an inaccurate probe inducer response (19%), were excluded. In addition, all trials in the practice block were excluded from the analyses.

Door Game. The analyses for The Door Game were identical to the first experiment.

IBR. To investigate the instruction-based reflexivity, three within-subject repeated measures ANOVA models (type III) were constructed for reaction times, error rates, and IES in diagnostic trials with compatibility (compatible or incompatible) and type of instructor (trustworthy or untrustworthy) as a within-subject factor. To examine the influence of trustworthiness on the inducer task, a paired sample test, comparing the reaction times, error rates and IES following instructions from the trustworthy or untrustworthy avatars was conducted. Additionally, a Pearson correlation was calculated to investigate the association between the amount of money earned during The Door Game and the interaction effect of the reaction times on the diagnostic runs.

Results

Door Game. A paired sample t-test showed that participants significantly followed the trustworthy avatar (M_{follow} = .93, SD_{follow} = .11, SE_{follow} = .01) more than the untrustworthy avatar (M_{follow} = .33, SD_{follow} = .07, SE_{follow} < .001), *t*(97) = 48.30, *p* < .001, *d* = 4.88. Additionally, participants were significantly faster to select a door when the avatar was trustworthy (M_{RT} = 730 ms, SD_{RT} = 541, SE_{RT} = 55), compared with untrustworthy (M_{RT} = 908 ms, SD_{RT} = 561, SE_{RT} = 57), as analyzed with a paired-sample t-test, *t*(97) = -7.80, *p* < .001, *d* = -.79.

IBR - Diagnostic trials. A repeated measure ANOVA on reaction times showed a significant main effect of compatibility, *F*(1,97) = 55.56, *p* <.001, *MSE* = .001, η_p^2 = .36, but no main effect of trustworthiness, *F*(1,97) = 1.87, *p* = .17, *MSE* = .001, η_p^2 = .02, nor an interaction effect, *F*(1,97) = 1.28, *p* = .26, *MSE* < .001, η_p^2 = .01. The same significant main effect of compatibility was found for the error rates, *F*(1,97) = 53.71, p < .001, *MSE* = .004, η_p^2 = .36, as well as the same non-significant main effect of trustworthiness , *F*(1,97) = 0.05, *p* = .83, *MSE* = .002, η_p^2 = .00, and a non-significant interaction effect *F*(1,97) = 1.42, *p* = .24, *MSE* = .002, η_p^2 = .01. Likewise, analyses of the IES demonstrated a significant main effect of compatibility *F*(1,97) = 72.43, *p* < .001, *MSE* = .006, η_p^2 = .43, a non-significant main effect of trustworthiness *F*(1,97) = 1.51, *p* = .22, *MSE* = .003, η_p^2 = .02, and non-significant interaction effect, *F*(1,97) = 2.56, *p* = .11, *MSE* = .003, η_p^2 = .03 (see Figure 3).

To investigate the influence of earned money on the reaction times, a Pearson correlation was calculated between the amount of money earned and the reaction times interaction effect. Prior, the difference scores (i.e., ($RT_{trustworthy\_compatible}$ - $RT_{trustworthy\_incompatible}$) - ($RT_{untrustworthy\_compatible}$ - $RT_{untrustworthy\_incompatible}$)), which reflect this interaction effect were calculated. This resulted in a non-significant correlation, *r* = -.06, *p* = .57.

IBR - Inducer task. A paired sample t-test revealed no significant difference between the reaction times following instructions from trustworthy (M_{RT} = 820, SD_{RT} = 199, SE_{RT} = 20) and untrustworthy (M_{RT} = 830, SD_{RT} = 206, SE_{RT} = 21) instructors, *t*(97) = -0.91, *p* = .36, *d* = -.09. Similar, no significant difference was found between error rates for trustworthy (M_{ER} = .19, SD_{ER} = .14, SE_{ER} = .01) and untrustworthy (M_{ER} = .18, SD_{ER} = .13, SE_{ER} = .01) instructors, *t*(97) = .18, *p* = .86, *d* = .02, and for the IES for trustworthy (M_{IES} = 1.06, SD_{IES} = .42, SE_{IES} = .04) and untrustworthy (M_{IES} = 1.06, SD_{IES} = .41, SE_{IES} = .04) instructors, *t*(97) = -.08, *p* = .93, *d* = .00.

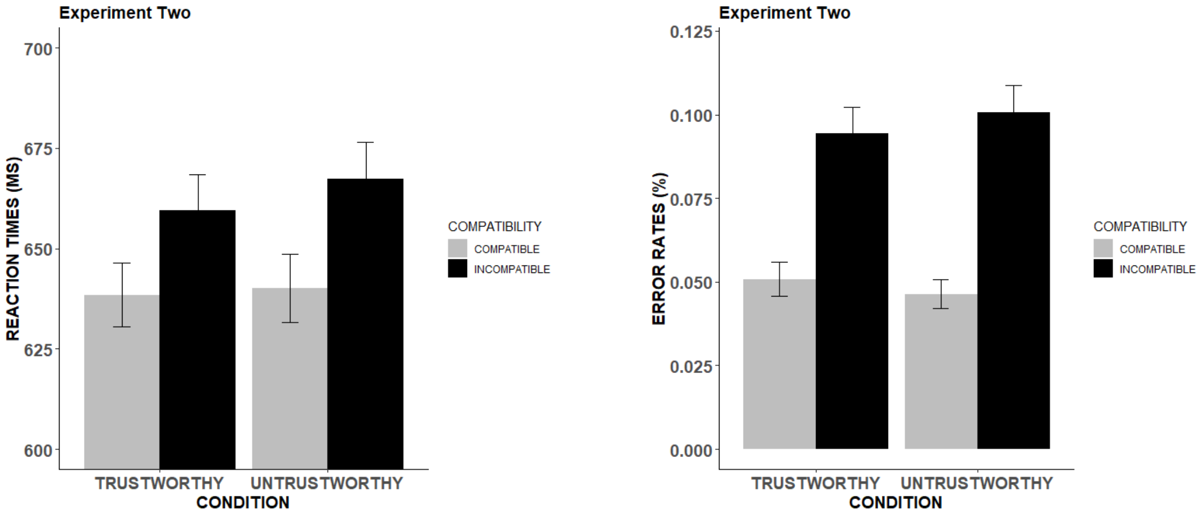

Figure 3. Mean error rates and reaction times for the second experiment. All error bars are ± standard error of the mean. Both reaction times and error rates are depicted separately for instructor trustworthiness (i.e., trustworthy and untrustworthy) and compatibility (i.e., compatible and incompatible). We found a significant main effect of compatibility, as participants were faster and made fewer errors during the compatible diagnostic trials, irrespectively of the trustworthiness of the instructor.

Discussion Experiment 2

The results of the second experiment replicate the effectiveness of The Door Game in manipulating the trustworthiness of the avatars. That is, participants, followed the untrustworthy avatar significantly less and more slowly than the trustworthy avatar, and 79% of the participants indicated that the trustworthy avatar was highly trustworthy (i.e., *"5"* on a Likert scale) and the untrustworthy avatar highly untrustworthy (i.e., *"1"*).

The results of the diagnostic task of the IBR paradigm revealed significant main effects of compatibility for reaction times, error rates, and IES, replicating previous studies on the reflexive effects of instructions (e.g. Liefooghe et al., 2012; Meiran et al., 2015) and extending these by showing that an IBR of similar size can be obtained via verbally instructing participants. However, in contrast with our predictions, there was no interaction between this compatibility effect and trustworthiness, nor a main effect of trustworthiness. Similarly, there was no main effect of trustworthiness on the inducer task.

The goal of the third experiment was to replicate the results of the second study, provide clear evidence that IBR can be induced with verbally conveyed instructions, and that The Door Game is a valid manipulation of trustworthiness. Most importantly, we wanted to provide further evidence for the absence of an interaction. Finally, a memory task was added to the general design of the second experiment to explore whether participants memorized S-R mappings instructed by the untrustworthy avatar more compared to the trustworthy avatar.

Experiment 3

Method

Participants. All 155 participants (136 female and 1 non-binary, M_{age} = 18.86 years, SD_{age} = 2.92, all naïve to the purpose of the experiment) were first-year psychology students at Ghent University that participated in return for a monetary performance reward and a course credit. This large sample size, as well as the exclusion criteria and analysis plan, were preregistered (https://aspredicted.org/yw6w4.pdf). For the analyses, 40 participants were excluded, due to too many mistakes on the diagnostic or the inducer task (*N* = 14), a failure to manipulate the trustworthiness as measured with the Likert scale questionnaire (*N* = 21), or both (*N* = 5). Note, that the same exclusion criteria are applied as experiment two.

Task and procedure. The apparatus, materials, and design were identical to the second experiment, but an additional memory task was given at the end of the experiment. Participants were presented the 42 S-R rules they executed during the IBR task and 42 newly constructed S-R rules, which consisted of the same words as the executed rules but in a different order and with a possible switched left or right position. Participants had to indicate if they had executed this S-R mapping (e.g., “press C”) during the IBR task or not (e.g., “press M”). There was no time limit during this task, and prior to each rule, a fixation cross was presented for 200 ms. The order of the S-R mappings was randomized.

Analyses

The analyses and preprocessing were identical to the second experiment. All runs with an inaccurate probe inducer response (15%) and all diagnostic trials following an error (8%) or with a response time faster than 200 ms (<.001%) were excluded from the analysis. For exploratory purposes, the analyses of the diagnostic trials were repeated with block order as an additional factor, and a Pearson correlation between IES and the amount of money earned during The Door Game calculated. To investigate the performance on the memory task, a two-tailed paired sample t-test was conducted. Moreover, to increase statistical power, the data of the second and third experiments were also combined in pooled analyses. Finally, Bayesian analyses were conducted on the diagnostic runs in the pooled analyses, for which the default settings of JASP (JASP Team, 2018) were used.

Results

Door Game. Participants significantly followed the advice of the untrustworthy avatar (M_{follow} = .32, SD_{follow} = .06, SE_{follow} < .00) less compared to the trustworthy avatar (M_{follow} = .94, SD_{follow} = .12, SE_{follow} = .01) as shown by a paired samples t-test, $t(114) = 50.82$, $p < .001$, d = 4.74. In the same vein, a paired samples t-test showed that participants were significantly faster to select a door following the advice of the trustworthy avatar (M_{RT} = 688 ms, SD_{RT} = 309, SE_{RT} = 29) compared to the untrustworthy avatar (M_{RT} = 849 ms, SD_{RT} = 435, SE_{RT} = 41), $t(114) = -5.93$, $p < .001$, $d = -0.55$.

IBR - Diagnostic trials. To examine the main effects of trustworthiness, compatibility and the interaction effect, for the reaction times, error rates, and IES, three within-subject repeated measures ANOVA models were constructed. For the reaction times, only a significant main effect of compatibility was found, $F(1,114) = 53.62$, $p < .001$, $MSE < .001$, $\eta_p^2 = .32$, while both the main effect of trustworthiness, $F(1,114) = 1.11$, $p = .29$, $MSE = .001$, $\eta_p^2 = .00$, and the interaction effect $F(1,114) = 0.08$, $p = .78$, $MSE < .001$, $\eta_p^2 = .00$, remained non-significant. Likewise, the analysis of the error rates, demonstrated the absence of a main effect of trustworthiness, $F(1,114) = 1.17$, $p = .28$, $MSE = .001$, $\eta_p^2 = .01$, and interaction effect $F(1,114) = 0.51$, $p = .48$, $MSE = .002$, $\eta_p^2 = .00$, but a significant main effect of compatibility $F(1,114) = 20.98$, $p < .001$, $MSE = .005$, $\eta_p^2 = .16$, was found. For the IES, the analysis showed a significant main effect of compatibility, $F(1,114) = 25.30$, $p < .001$, $MSE = .01$, $\eta_p^2 = .18$, and trustworthiness, $F(1,114) = 4.57$, $p = .03$, $MSE = .003$, $\eta_p^2 = .04$, but a non-significant interaction effect, $F(1,114) = 0.19$, $p = .66$, $MSE = .003$, $\eta_p^2 = .00$ (see Figure 3). The main effect of trustworthiness indicates that the IES was larger for the trustworthy than for the untrustworthy avatar (see Supplementary Table).

In order to investigate the three-way interaction between trustworthiness, compatibility and block order, three additional within-subject repeated measures ANOVAs were constructed. Mauchly's test indicated a violation of the sphericity assumption for reaction times *Mauchly's W* = .743, p <.001, *Greenhouse-Geisser* ε = .865, error rates *Mauchly's W* = .747, p

<.001, *Greenhouse-Geisser* ε = .872, and IES *Mauchly's W* = .156, p < .001, *Greenhouse Geisser* ε = .483. Therefore, the p-values were corrected with the Greenhouse-Geisser correction. Analyses showed a non-significant three-way interaction for reaction times, $F(3.46,366.82) = 0.76$, $p = .53$, $MSE = .005$, $\eta_p^2 < .01$, for error rates $F(3.49, 380.07) = 0.34$, $p = .83$, $MSE = .007$, $\eta_p^2 < .01$, and for IES $F(1.93, 204.67) = 0.58$, $p = .56$, $MSE = .08$, $\eta_p^2 < .01$.

A Pearson correlation, associating the reaction time interaction effect (i.e., difference scores) and amount of money earned during The Door Game, yielded a non-significant negative correlation, $r = -.02$, $p = .81$. In a similar vein, a negative non-significant correlation between the amount of money earned and the interaction effect of the IES was found, $r = -.03$, $p = .75$.

IBR - Inducer task. A paired sample t-test showed no significant difference between the reaction times on trustworthy (M_{RT} = 860 ms, SD_{RT} = 187, SE_{RT} = 17) compared to untrustworthy (M_{RT} = 861, SD_{RT} = 188, SE_{RT} = 18) instructors, $t(114) = -0.08$, $p = .94$, $d < -.01$. In similar vein, no significant difference between the error rates for trustworthy (M_{ER} = .14, SD_{ER} = .12, SE_{ER} = .01) and untrustworthy instructors (M_{ER} = .16, SD_{ER} = .13, SE_{ER} = .01), $t(114) = -1.05$, $p = .29$, $d = -.10$, and for IES scores for trustworthy (M_{IES} = 1.03, SD_{IES} = .30, SE_{IES} = .03) and untrust worthy (M_{IES} = 1.08, SD_{IES} = .46, SE_{IES} = .04) instructors was found, $t(114) = -1.24$, $p = .22$, $d = -.12$.

Memory. A paired sample t-test demonstrated that the accuracies were significantly larger for the instructions that were given by the untrustworthy avatar in the IBR experiment (M = .48, SD = .16, SE = .02) compared to instructions that were given by the trustworthy avatar (M = .45, SD = .17, SE = .01), $t(114) = 1.63$, $p = .05$, $d = .15$. However, it is important to note, that both accuracy rates were beneath change level, although, this was only significant, as tested with a one sample t-test for the trustworthy $t(114) = -3.23$, $p < .001$, $d = -.30$, but only marginally significant for the untrustworthy avatar, $t(114) = -1.52$, $p = .07$, $d = -.14$.

Pooled Results

For exploratory purposes, and to increase statistical power, we also combined the data of the second and the third experiment (N = 213, $M_{age} = 19.15$, $SD_{age} = 3.64$) and repeated the aforementioned analyses.

IBR - Diagnostic trials. Analyses with three repeated measure ANOVAs showed that there was a main effect of compatibility for reaction times $F(1,212) = 108.68$, $p < .001$, $MSE < .001$, $\eta_p^2 = .34$, error rates, $F(1,212) = 66.75$, $p < .001$, $MSE = .004$, $\eta_p^2 = .24$, and IES, $F(1,212) = 78.98$, $p < .001$, $MSE = .009$, $\eta_p^2 = .27$. In contrast, there was no evidence for a main effect of trustworthiness for reaction times $F(1,212) = 0.02$, $p = .89$, MSE = .001, $\eta_p^2 = .00$, error rates $F(1,212) = 0.37$, $p = .54$, $MSE = .001$, $\eta_p^2 = .00$, or IES $F(1,212) = 0.71$, $p = .40$, $MSE = .003$, $\eta_p^2 = .00$, nor for an interaction effect, $F(1,212) = 0.96$, $p < .33$, $MSE < .001$, $\eta_p^2 = .00$; $F(1,212) = 0.13$, $p = .72$, $MSE = .001$, $\eta_p^2 = .00$;$F(1,212) = 0.64$, $p = .42$, $MSE = .003$, $\eta_p^2 = .00$ (see Figure 4).

Equivalent Bayesian analyses of the reaction times revealed strong evidence in favor of the null effect of trustworthiness $BF_{01} = 12.5$, and an interaction, $BF_{01} = 6.67$, while we found strong evidence for the main effect of compatibility, $BF_{10} > 150$. In a similar vein, Bayesian analysis for the error rates, demonstrated evidence for a non-significant main effect of trust-worthiness, $BF_{01} = 12.5$ or interaction effect, $BF_{01} = 9.09$, however, clear evidence for a main effect of compatibility was found, $BF_{10} > 150$. Furthermore, there was clear evidence for the main effect of compatibility for IES, $BF_{10} > 150$, while there was no evidence for the main effect of trustworthiness, $BF_{01} = 11.11$, nor interaction effect, $BF_{10} = 7.69$.

IBR - Inducer task. A paired sample t-test comparing the reaction times on trustworthy (M_{RT} = 841 ms, SD_{RT} = 193, SE_{RT} = 13) compared to untrustworthy (M_{RT} = 847 ms, SD_{RT} = 197, SE_{RT} = 13) showed a non-significant difference, $t(212) = -0.69$, $p = .49$, $d = -.05$, similar results were found for the trustworthy error rates ($M_{ER} = .16$, $SD_{ER} = .13$, $SE_{ER} < .01$) and untrustworthy error rates ($M_{ER} = .17$, $SD_{ER} = .13$, $SE_{ER} < .01$), $t(212) = -0.70$, $p = .48$, $d = -.05$, and for trustworthy IES ($M_{IES} = 1.05$, $SD_{IES} = .36$, $SE_{IES} = .02$) and untrustworthy IES scores ($M_{IES} = 1.07$, $SD_{IES} = .43$, $SE_{IES} = .03$), $t(212) = -1.07$, $p = .29$, $d = -.07$.

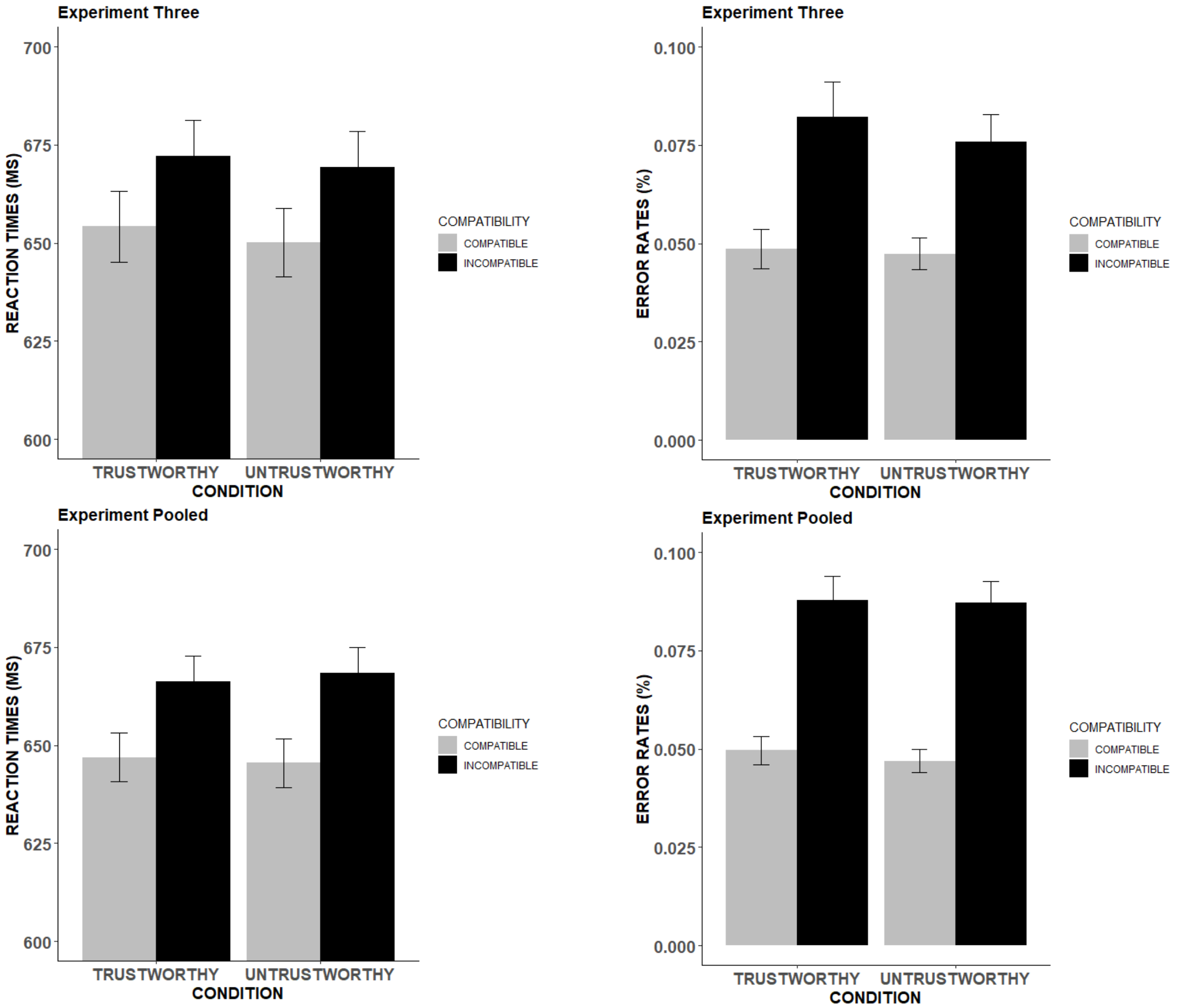

Figure 4. Mean error rates and reaction times for the second experiment and pooled analysis. Reaction times and error rates are depicted according to the compatibility and instructor trustworthiness. A significant main effect of compatibility was found irrespectively of the interaction with the trustworthiness of the instructor. All error bars are ± standard error of the mean.

Discussion Experiment 3

The third experiment successfully replicated the results of the second experiment. Participants responded slower, made more mistakes, and showed larger IES on incompatible diagnostic trials compared to compatible ones. However, there was no main effect of trustworthiness nor a significant interaction between trustworthiness and compatibility on the diagnostic runs nor on the inducer trials. In addition, pooled analyses of the second and third experiments confirmed this significant main effect of compatibility during the diagnostic runs as well as the absence of a trustworthiness or interaction effect, despite the large sample.

General Discussion

Here, we investigated the effect of trustworthiness on automatic instruction implementation. In a first study, we developed and validated a new trustworthiness manipulation, using both explicit and implicit measures. Results revealed that participants followed the advice of the trustworthy avatar more and implicitly associated this avatar more with trustworthiness than the untrustworthy avatar. The results of the second and third experiments replicated the classic IBR effect (Liefooghe et al., 2012; Meiran et al., 2015) using verbal instead of written instructions. However, this effect was not modulated by the trustworthiness of the instructor, and these results were replicated in a third study. Additionally, the results of The Door Game of the second and the third experiment confirmed the validity of our trustworthiness manipulation.

By using verbal instructions presented by virtual avatars, we created a novel 'social' version of the IBR paradigm that is ecologically more valid, allowing for contextual (e.g. social) manipulations. Experiment two and three provide more evidence for the automatic power of new instructions on ongoing behavior (Liefooghe et al., 2012; Meiran et al., 2015), even without printed S-R mappings but with instructions given by virtual characters with differing social characteristics (i.e., trustworthiness). However, in contrast to our predictions, with the current experimental paradigm, the trustworthiness of the instructor did not modulate this automatic effect. While there was a clear effect of advisor trustworthiness on explicit responding behavior in The Door Game, hence demonstrating the influence of trust on ongoing behavior (Hale et al., 2018; van 't Wout & Sanfey, 2008), this effect did not transfer to implicit behavior, as measured with the diagnostic trials.

There are at least three possible explanations for the absence of an effect of trustworthiness on implicit measures of instruction following. First, it could be that the trust associations established during The Door Game did not transfer to the IBR. Indeed, in the IBR task, participants must always follow the instruction, irrespective of the instructor, and hence all instructors were *trustworthy* during these blocks. Whereas previous research has found such transfer effects of social variables to unrelated behavior in other tasks (e.g. Cracco et al., 2018; Hale et al., 2018), future research will be needed to fully rule out a possible lack of transfer due to the design of the IBR task itself.

Second, it is possible that the instructor trustworthiness established in The Door Game does transfer to the IBR task but does not modulate the IBR effect. While the IBR has repeatedly been shown to be modulated by cognitive variables effect, such as working memory load or the intention to implement (Meiran & Cohen-Kdoshay, 2012; Muhle-Karbe et al., 2016), and has found to be correlated with intelligence (Meiran, Pereg Givon, Danieli, & Shahar, 2016), this reflexivity effect might be insensitive to contextual manipulations, such as the aforementioned social context. For example, Braem, Liefooghe, De Houwer, Brass, and Abrahamse (2017) investigated the context-dependency of task instructions and demonstrated that contextual task information modulates the performance on the IBR only when the inducer task was practiced or trained on this specific context. However, this context-dependency effect was absent for novel S-R mappings. It could thus be that the IBR effect is insensitive not only to social context but to all contextual manipulations. It is important to note, however, that the IBR effect reflects only one aspect of instruction following, namely instruction implementation, or the formation of an action-oriented representation. It is possible that social variables modulate instruction following only in an earlier stage, prior to the formation of the action-oriented format (i.e., *"when the instruction is still in its declarative format")* or when transforming the declarative format into an action-oriented format (Brass et al., 2017), and that this effect is filtered out when instructions are represented in action-oriented representation.

Finally, it is possible that instruction implementation is not modulated by social variables. However, this would contrast with recent prominent proposals. For example, Heyes (2018), argued that human adaptive behavior evolved not only through genetics but also through cultural evolution and that the latter is built on social metacognitive capacities such as instruction following. Similarly, in their theoretical framework of instruction following, De Houwer, Hughes, and Brass, (2017) emphasized the crucial role of instructions in society, as without instructions an essential line of information communication would be lost. It would also contrast with empirical evidence showing that the credibility of the instructor modulates the strength and hence influence of the message (e.g., Vogel & Wänke, 2016), and with evidence showing that a broad variety of social variables can modulate decision-making processes (e.g. for a review see van den Bos, Jolles, & Homberg, 2013). In the same vein, it has repeatedly been shown that social context has a profound influence on explicit instruction following, as for example, when monitored by an observer, the probability of instruction following significantly increases (Donadeli & Strapasson, 2015), or increased direction following when instructed by a trustworthy compared to an untrustworthy avatar (Hale et al., 2018).

In summary, the current study succeeded in designing a novel paradigm to manipulate an abstract social concept, namely trustworthiness. Furthermore, we were able to design a 'social' version of the IBR paradigm in which an avatar gives verbal instructions. This paradigm showed similar IBR effects compared with previous paradigms using written instructions. However, in contrast to our expectations, we were unable to demonstrate an effect of social variables on instruction implementation. There are different potential reasons why this might be the case and future research will have to explore different approaches to manipulate trust and target different phases of instruction processing, implementation, and following to provide a definitive answer on whether and at which level trustworthiness modulates instructions following.

Open practices statement

Raw and preprocessed data, analyses scripts, JASP files, and virtual avatar stimuli for all the experiments can be found here, as well as all preregistrations.

Funding

M.V.D.B. and C.G.G. were supported by Special Research Fund of Ghent University BOF.GOA.2017.0002.03. DW was supported by the Research Foundation Flanders (FWO), the European Union's Horizon 2020 research and innovation program under the Marie Skłodowska-Curie grant agreement No 665501, and FWO grant FWO.KAN.2019.0023.01. E.C. is funded by the Research Foundations Flanders (FWO18/PDO/049).

References

Altemeyer, B. (1998). The Other "Authoritarian Personality". In *Advances in Experimental Social Psychology* (Vol. 30, pp. 47–92). Doi: 10.1016/S0065-2601(08)60382-2

Ashraf, N., Bohnet, I., & Piankov, N. (2006). Decomposing trust and trustworthiness. *Experimental Economics*, *9*(3), 193–208. Doi: 10.1007/s10683-006-9122-4

Baarendse, P. J. J., Counotte, D. S., O'Donnell, P., & Vanderschuren, L. J. M. J. (2013). Early Social Experience Is Critical for the Development of Cognitive Control and Dopamine Modulation of Prefrontal Cortex Function. *Neuropsychopharmacology*, *38*(8), 1485–1494. Doi: 10.1038/npp.2013.47

Braem, S., Liefooghe, B., De Houwer, J., Brass, M., & Abrahamse, E. L. (2017). There are limits to the effects of task instructions: Making the automatic effects of task instructions context-specific takes practice. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *43*(3), 394–403. Doi: 10.1037/xlm0000310

Brass, M., Liefooghe, B., Braem, S., & De Houwer, J. (2017). Following new task instructions: Evidence for a dissociation between knowing and doing. *Neuroscience & Biobehavioral Reviews*, *81*, 16–28. Doi: 10.1016/j.neubiorev.2017.02.012

Cole, M. W., Bagic, A., Kass, R., & Schneider, W. (2010). Prefrontal Dynamics Underlying Rapid Instructed Task Learning Reverse with Practice. *Journal of Neuroscience*, *30*(42), 14245–14254. Doi: 10.1523/JNEUROSCI.1662-10.2010

Cole, M. W., Laurent, P., & Stocco, A. (2013). Rapid instructed task learning: A new window into the human brain's unique capacity for flexible cognitive control. *Cognitive, Affective, & Behavioral Neuroscience*, *13*(1), 1–22. Doi: 10.3758/s13415-012-0125-7

Cracco, E., Genschow, O., Radkova, I., & Brass, M. (2018). Automatic imitation of pro- and antisocial gestures: Is implicit social behavior censored? *Cognition*, *170*, 179–189. Doi: 10.1016/j.cognition.2017.09.019

De Houwer, J., Hughes, S., & Brass, M. (2017). Toward a unified framework for research on instructions and other messages: An introduction to the special issue on the power of instructions. *Neuroscience & Biobehavioral Reviews*, *81*, 1–3. Doi: 10.1016/j.neubiorev.2017.04.020

Donadeli, J. M., & Strapasson, B. A. (2015). Effects of Monitoring and Social Reprimands on Instruction-Following in Undergraduate Students. *The Psychological Record*, *65*(1), 177–188. Doi: 10.1007/s40732-014-0099-7

González-García, C., Arco, J. E., Palenciano, A. F., Ramírez, J., & Ruz, M. (2017). Encoding, preparation and implementation of novel complex verbal instructions. *NeuroImage*, *148*, 264–273. Doi: 10.1016/j.neuroimage.2017.01.037

González-García, C., Formica, S., Liefooghe, B., & Brass, M. (2020). Attentional prioritization reconfigures novel instructions into action-oriented task sets. *Cognition*, *194*, 104059. Doi: 10.1016/j.cognition.2019.104059

Greenwald, A. G., Nosek, B. A., & Banaji, M. R. (2003). Understanding and using the Implicit Association Test: I. An improved scoring algorithm. *Journal of Personality and Social Psychology*, *85*(2), 197–216. Doi: 10.1037/0022-3514.85.2.197

Hale, J., Payne, M. E., Taylor, K. M., Paoletti, D., & De C Hamilton, A. F. (2018). The virtual maze: A behavioural tool for measuring trust. *Quarterly Journal of Experimental Psychology*, *71*(4), 989–1008. Doi: 10.1080/17470218.2017.1307865

Heyes, C. (2018). Enquire within: Cultural evolution and cognitive science. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *373*(1743), 20170051. Doi: 10.1098/rstb.2017.0051

JASP Team (2018). JASP (Version 0.9)[Computer software].

Liefooghe, B., De Houwer, J., & Wenke, D. (2013). Instruction-based response activation depends on task preparation. *Psychonomic Bulletin & Review*, *20*(3), 481–487. Doi: 10.3758/s13423-013-0374-7

Liefooghe, B., Demanet, J., & Vandierendonck, A. (2010). Persisting activation in voluntary task switching: It all depends on the instructions. *Psychonomic Bulletin & Review*, *17*(3), 381–386. Doi: 10.3758/PBR.17.3.381

Liefooghe, B., Wenke, D., & De Houwer, J. (2012). Instruction-based task-rule congruency effects. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *38*(5), 1325–1335. Doi: 10.1037/a0028148

McGinnies, E., & Ward, C. D. (1980). Better Liked than Right: Trustworthiness and Expertise as Factors in Credibility. *Personality and Social Psychology Bulletin*, *6*(3), 467–472. Doi: 10.1177/014616728063023

Meiran, N., & Cohen-Kdoshay, O. (2012). Working memory load but not multitasking eliminates the prepared reflex: Further evidence from the adapted flanker paradigm. *Acta Psychologica*, *139*(2), 309–313. Doi: 10.1016/j.actpsy.2011.12.008

Meiran, N., Liefooghe, B., & De Houwer, J. (2017). Powerful Instructions: Automaticity Without Practice. *Current Directions in Psychological Science*, *26*(6), 509–514. Doi: 10.1177/0963721417711638

Meiran, N., Pereg, M., Givon, E., Danieli, G., & Shahar, N. (2016). The role of working memory in rapid instructed task learning and intention-based reflexivity: An individual differences examination. *Neuropsychologia*, *90*, 180–189. Doi: 10.1016/j.neuropsychologia.2016.06.037

Meiran, N., Pereg, M., Kessler, Y., Cole, M. W., & Braver, T. S. (2015). The power of instructions: Proactive configuration of stimulus–response translation. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *41*(3), 768–786. Doi: 10.1037/xlm0000063

Muhle-Karbe, P. S., Duncan, J., De Baene, W., Mitchell, D. J., & Brass, M. (2016). Neural Coding for Instruction-Based Task Sets in Human Frontoparietal and Visual Cortex. *Cerebral Cortex*, bhw032. Doi: 10.1093/cercor/bhw032

Nakahara, K. (2002). Functional MRI of Macaque Monkeys Performing a Cognitive Set-Shifting Task. *Science*, *295*(5559), 1532–1536. Doi: 10.1126/science.1067653

Peirce, J. W., Gray, J. R., Simpson, S., MacAskill, M. R., Höchenberger, R., Sogo, H., Kastman, E., Lindeløv, J. (2019). PsychoPy2: experiments in behavior made easy. *Behavior Research Methods.* Doi: 10.3758/s13428-018-01193-y

R Core Team (2017). R: A language and environment for statistical computing. Vienna, Austria: R Foundation for Statistical Computing; 2016.

van den Bos, R., Jolles, J. W., & Homberg, J. R. (2013). Social modulation of decision-making: A cross-species review. *Frontiers in Human Neuroscience*, *7*. Doi: 10.3389/fnhum .2013.00301

van 't Wout, M., & Sanfey, A. G. (2008). Friend or foe: The effect of implicit trustworthiness judgments in social decision-making. *Cognition*, *108*(3), 796–803. Doi: 10.1016/j.cogn ition.2008.07.002

Verrico, C. D., Liu, S., Asafu-Adjei, J. K., Sampson, A. R., Bradberry, C. W., & Lewis, D. A. (2011). Acquisition and baseline performance of working memory tasks by adolescent rhesus monkeys. *Brain Research*, *1378*, 91–104. Doi: 10.1016/j.brainres.2010.12.081

Vogel, T., & Wänke, M. (2016). *Attitudes and attitude change* (2nd ed.). NY: Routledge/Taylor & Francis Group.

Wang, X., Wang, N., Han, S., Liu, S., & Zhang, L. (2018). The influence of facial trustworthiness on helping behavior: The role of attachment type. *Acta Psychologica Sinica*, *50*(11), 1292. Doi: 10.3724/SP.J.1041.2018.01292

Wenke, D., Gaschler, R., Nattkemper, D., & Frensch, P. A. (2009). Strategic influences on implementing instructions for future actions. *Psychological Research Psychologische Forschung*, *73*(4), 587–601. Doi: 10.1007/s00426-009-0239-x

Whitehead, P. S., & Egner, T. (2018). Frequency of prospective use modulates instructed task-set interference. *Journal of Experimental Psychology: Human Perception and Performance*, *44*(12), 1970–1980. Doi: 10.1037/xhp0000586

Appendix A

Subjectnumber:……..

1) “Did you perceive a difference in the behavior of the two avatars during the game?”

2) “If so, at what point during the experiment did you realize this difference?”