Personality Traits, Locus of Control, and Susceptibility to Social Influence in Agency Judgments

Abstract

It has been suggested that sense of agency might be jointly affected by situational and inter-individual factors. In this study, we examine if personality traits and locus of control beliefs can explain inter-individual differences in both (1) sense of agency and (2) how susceptible people are to social influence in relation to their agency judgments.. To test this, we employ measures for the Big Five Personality Traits and Levenson's Locus of Control in combination with a task based on an interactive computer game. We manipulate sensorimotor agency cues related to action control as well as the social information communicated to participants. Our findings show that while locus of control beliefs are related to differences in sense of agency, neither big five personality traits nor locus of control beliefs can account for participants' interpersonal variance in susceptibility to social influence.

Keywords: **s**ense of agency; social influence; locus of control; advise taking; change-of-mind; social cognition; big five personality traits

1. Introduction

The phenomenology of agency has been extensively studied in recent decades (Bonicalzi & Haggard 2019, Moore 2016). One of the key components of agentive phenomenology and voluntary actions is the sense of agency: The feeling that we are in control of our actions and through them external events in the world (Beck et al. 2017, Bonicalzi et al. 2019). A functional sense of agency is a crucial internal marker for correct estimations of one's control and is closely related to feelings of responsibility (Bigenwald & Chambon 2019). It is commonly thought that sense of agency depends on actively monitoring two types of information (Moore 2016, Moore & Haggard 2008): (1) Internal information, such as signals relating to motor commands (Blakemore et al. 2002), action fluency (Sidarus et al. 2017, Chambon et al. 2014), and metacognition (Metcalfe et al. 2010), and (2) external information such as sensory feedback and social cues (Wegner et al. 2004, Wegner & Sparrow 2004). Traditionally, sense of agency and its underlying processes have been studied in non-social contexts (Sidarus et al. 2020, Haggard & Eitam 2015) where participants sit in isolation and freely decide *when* to act or *what* to do (Ras et al. 2019, Schultze-Kraft et al. 2016, Soon et al. 2013). However, in everyday life, actions are often conducted in social situations. In such situations, the external information that feeds into the processes of sense of agency can be both social and non-social.

Recently, a range of studies have started investigating how social contexts and the processes of social cognition might affect sense of agency. For instance, it has been shown that the mere presence of other people reduces sense of agency over negative outcomes (Beyer 2017, 2018) and that mentalizing during the execution of an action can influence how much agency a person feels over the outcome (Sidarus et al. 2020). In addition, it has been shown that sense of agency is reduced when participants are coerced to execute their actions (Caspar et al. 2016), that sharing control in joint actions can both increase and decrease judgments of agency depending on the type of sensory feedback provided (Cho et al. 2020, Dewey et al. 2014), and that explicit social feedback from others can affect judgments of agency to closely align with disagreeing feedback (Baptista et al. 2022). Thus, the presence of other agents can have either passive effects as in the case of audience effects (Antonia & Lind 2016), or active effects as in cases of coercion or explicit feedback (Baptista et al. 2022, Caspar et al. 2016).

While some studies investigate the effects of social influences on sense of agency, less is known about the underlying factors that mediate this association. It has been suggested that sense of agency is jointly affected by both situational and inter-individual factors (Tapal et al. 2017, Schwarz et al. 2022, Dewez et al. 2019, Jeunet et al. 2018). In this paper, we suggest that two types of trait-like constructs can explain part of the inter-individual differences in 1) sense of agency itself and 2) in the propensity of subjects to modulate it through explicit feedback provided by other agents.

The 1st trait of interest is the locus of control. Locus of control captures the degree to which people believe that they themselves, in contrast to external forces, are in control of the outcomes in their lives (Rotter 1954, Levenson 1981). That is to say, people with high internal locus of control perceive themselves as having much personal control whereas people with an external locus of control are more likely to attribute a higher role to external factors. The Levenson locus of control scale is particularly useful for our purpose, as it captures not only the internal/external distinction, but also captures distinct social and non-social aspects of external influence. The social-external category is called "powerful others". This construct captures the extent to which people believe the outcomes in their lives are affected by powerful other agents. The non-social-external category is called "chance" and expresses the extent to which people believe the outcomes in their lives are affected by natural non-agentive randomness in the external world. Previous studies connecting locus of control with sense of agency have shown that internal locus of control correlate with higher sense of agency (Dewez et al. 2019, Jeunet et al. 2018). Here, we aim to investigate more thoroughly than has been done previously how locus of control relate to sense of agency, as well as how differences in locus of control affect the integration of social information in relation to agency judgments.

The 2nd set of traits we are interested in here are the big five personality traits. The big five personality traits have

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been previously shown to link with susceptibility to social influence (Oyibo & Vassileva 2019, Caldwell & Burger 1997, Oyibo et al. 2017, Anagnostopoulou et al. 2017) one the one hand and to sense of agency on the other hand (Schwarz et al. 2022). The big five personality traits compose a model of personality traits with wide application across different domains due to its empirical validity (Roccas et al. 2002, McCrae & John 1992). The five traits measured by the big five personality questionnaire are (1) Agreeableness: Characterizes people who are friendly, sympathetic, approachable, modest, non-confrontational and less competitive. (2) Conscientiousness: Characterizes people who are self-disciplined, goal-oriented and well-organized. (3) Neuroticism: Characterizes those who are anxious, nervous, and fearful. People in this category tend to be emotionally unstable, feel less confident and insecure about themselves. (4) Extraversion: Characterizes those who tend to socialize and interact with others. (5) Openness: Characterizes people who are curious, imaginative, and open to new ideas and experiences. Of these, neuroticism has been found to be related to a reduced sense of agency, while the other traits have been found to be related to a higher sense of agency (Schwarz et al. 2022). The traits Neuroticism, conscientiousness, and openness have been shown to relate to social influence of the type "social proof", which is prototypically captured by the phrase "I often rely on other people to know what to do". These results show that conscientiousness and neuroticism are positively correlated with "social proof"-type influence, and that openness is negatively correlated with susceptibility to this type of social influence (Oyibo & Vassileva 2019).

In the present study, we investigate how individual personality traits and locus of control beliefs may affect integration of social feedback on agency judgments produced by subjects during a computerized "space invader-like" game (see section 2.1.3 to 2.1.5, see figures 1 and 2) where the motor component of the game playability was modulated without their knowledge. Our main hypotheses concern the relationships between locus of control, sense of agency, and susceptibility to social influence. We expect that high internal locus of control are related to higher sense of agency and a lower likelihood to align with social feedback, i.e. feedback provided by unfamiliar peers about the subject's reported agency judgment (In other words, a lower susceptibility to social influence). Based on a previous pilot study (N=112), we also expect people with a higher *social-external* locus of control, i.e. those with a higher 'powerful others' locus of control, to more likely align with social feedback. Furthermore, also on the basis of pilot results, we hypothesize that the Big Five personality trait "agreeableness" will be related to a higher susceptibility to social feedback.

2. Present Study

In a pre-registered experimental study (https://osf.io/ex5a6), we explored how trait-like constructs captured by the Levenson locus of control scale and the big five personality traits relate to sense of agency as well as to the integration of social feedback on agency judgments. We now attempt to test our pre-registered hypotheses on 562 typical adlts recruited online (via "Prolific Academic"), as well as to replicate previous findings in the literature, using a series of linear-mixed models.

Our hypotheses are that (H1) internal locus of control is related to higher sense of agency. (H2) The big five personality traits 'agreeableness', 'conscientiousness', 'extraversion', and 'openness' are related to a higher sense of agency while (H3) the trait 'neuroticism' is related to a lower sense of agency. In addition, we hypothesize that (H4) people with higher internal locus of control are less likely to revise their agency judgments based on social feedback, and that (H5) people with more social-external locus of control are more likely to revise their agency judgments based on social feedback. Finally, we expect (H6) people with higher scores on the big five traits 'agreeableness', 'conscientiousness', and 'neuroticism' to be more likely to revise their agency judgments based on social feedback, and (H7) people with higher scores on the 'openness' trait to be less likely to revise their agency judgments based on social feedback.

The experiment was built and run using JavaScript and presented digitally online. Ethical approval was granted by Comité d'Éthique de la Recherche -Sorbonne Université (N° 2019 – CER 2 SOTIPAD).

2.1 Materials & Method

2.1.1 Sample Size Calculation: Linear mixed-models were used to analyse the data. For such models, conventional power calculations are notoriously difficult to perform (Westfall et al. 2014, Kumle et al. 2021, Maxwell 2000). In the absence of existing data or an a priori hypothesis about the exact values of effect sizes, sample sizes are commonly based on previous studies. On this basis, and in line with more recent sample size recommendations, a sample of 40-60 participants would be appropriate (Brysbaert & Stevens 2018, Baptista et al. 2022, Olsen et al. 2019, Pescetelli & Yeung 2020, Metcalfe & Greene 2007). However, it has been suggested that many studies in psychology with less than 100 participants are at risk of being underpowered (Brysbaert 2019, Brooks & Barcikowski 2012, Knofczynski & Mundfrom 2008). Because we also wanted to use the dataset to do exploratory analysis to investigate relationships that we had no a priori hypotheses about, we decided on a target sample size of 500 participants.

2.1.2 Participants: Participants were recruited online via the recruitment service Prolific Academic (PA). Of 900 recruited participants, 12 were removed for being duplicate participants, 17 were removed for not completing all the task-trials, 38 had to be excluded because we lost part of the data due to a technical error, 269 were removed because they suspected that the "advisors" in the task were actually bots (see *Experiment*) or other types of non-human feedback. Additionally, 33 participants were removed because they did not complete filling out the relevant questionnaires (see *Measurement*). This left us with a total of 529 participants (277 Female and 252 Male). Participants were between 18 and 74 years of age, with a median age of 27. Participants were paid approximately 9£/H for their participation.

2.1.3 Experiment: The primary task of the experiment was a game where participants tried to catch downward scrolling stars and avoid touching circles (figure 1). Participants were instructed to use a computer mouse for the duration of the experiment. Using their mouse, participants could move a small white box called "The Catcher" back and forth across a horizontal track as 20 stimuli, 10 stars and 10 circles randomly generated and distributed across the play area, fell through the play area from the top of the screen. Participants were instructed to use The Catcher to "catch" stars and avoid catching the circles. If a hit occurred, the target would disappear, accompanied by a sound (either a "pling"-sound for catching a star or a "bzz"-sound for hitting a circle). If a target was not hit, it would continue traveling downward until it disappeared through the bottom of the screen. The game also included a score-counter in the top right corner. Participants were awarded 100 points for every star they caught and lost 50 points for every circle they hit. Participants played the game for 10 seconds on each trial, after which they were asked to indicate how much control they thought they had over the catcher ("How much control do you think you had over The Catcher?") on a 7-point Likert scale ranging from 1, "No control", to 7, "Full Control". The scale remained on screen until participants selected a value. After giving their first judgment of agency

Figure 1: Participants move the white square called "The Catcher" horizontally to try and catch the stars and avoid hitting the circles.

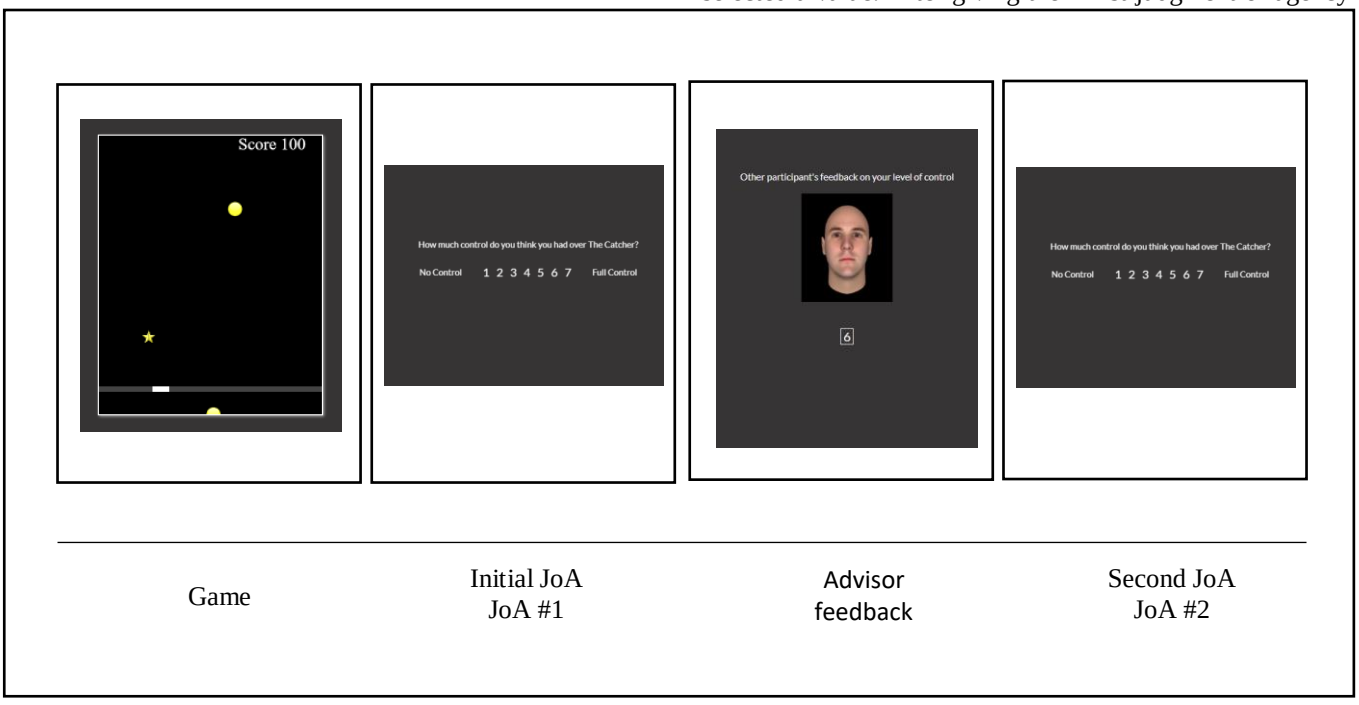

Figure 2: Typical trial: (1) Participants play the game, (2) then they provide their first agency rating (JoA #1), (3) then they receive advisor feedback, (4) then they provide their second agency rating (JoA #2). Social alignment is measured by comparing the first JoA (JoA #1) and second JoA (JoA #2).

(JoA #1), participants received feedback from an "online player" (the "advisor") about the degree of control they had during the game. The feedback from advisors was also given on a 7-point Likert scale. Then, participants were asked again to evaluate how much control they thought they had over The Catcher (JoA #2) (Figure 2). In reality, advisors were bogus agents designed to randomly agree or disagree with the participant's initial judgment (see *Manipulation of Social Feedback*).

Participants carried out 100 trials. Of these, 8 trials were non-social training trials, where participants did not receive any advisor feedback and were not asked to judge their level of a control a second time. Every 40th trial, the participants were asked to take a break. This break lasted a minimum of 30 seconds before participants were able to proceed. As part of the instructions, participants had been informed that they would have more or less control over The Catcher, that they would be asked to indicate their degree of control on a scale from 1 to 7, and that they would receive feedback about their control from other players. Though the advisors were in reality bogus agents, several steps were taken to strengthen the illusion that they were real players. When participants first entered the experiment, they were met with a loading-screen and the text "waiting for other players" to simulate the process of connecting different players online. Participants themselves were also tasked with occasionally playing the role of the advisor, observing trials of "other players", and giving them feedback on how much control they thought the observed players had. The trials observed were in reality pre-recorded trials. In addition, the avatars of the advisors would randomly change to simulate the experience that different players were advising them on different trials. At the end of the experiment participants were asked about how they thought the feedback they received was given ("How do you think feedback was provided?" and what they thought of their advisors "What did you think of your advisors?". This was done to check if participants believed that the advisors were real players or if they suspected them of being bots. Participants who indicated that they suspected the advisors of being bots (or other non-human mechanisms) were excluded from analysis.

After completing all 100 game trials, the participants were presented with a selection of questionnaires to fill out.

2.1.4 Manipulation of sensorimotor cues: Three game conditions were designed to manipulate internal sensorimotor agency cues by altering the control the participants had over The Catcher. In the CONTROL condition, the objective control of The Catcher was undisturbed (objectively, full control). In the TURBULENCE condition, objective control was impaired by turbulences (random noise) intervening between the mouse input and the position of The Catcher. In the MAGIC condition the radius of The Catcher was extended with an invisible extension that can catch the target stars but not the distractor circles. In this condition, the participant would sometimes be credited with catching a star even if they had not visibly touched it with The Catcher.

2.1.5 Manipulation of social feedback: The advisor would agree with the participant in one third of the trials (agreement trials) and disagree in two thirds of the trials (disagreement trials). In half of the disagreement trials (i.e. one third of the total trials), the advisor would disagree by indicating that the participant had less control than they had initially estimated (negative valence disagreement) and in the other half of the disagreement trials the advisor would disagree by indicating that the participant had more control than they had initially estimated (positive valence disagreement). Positive and negatively directed disagreements came in three different strengths, small (+1/-1), medium (+2/-2) or large (+3/-3). Thus social feedback varied by type (agree/disagree), disagreement direction (negative/positive), and disagreement strength (small, moderate, large). In cases where the strength of disagreement would extend beyond the ends of the scale (i.e. less than 1 or more than 7), the direction of the feedback was inversed (i.e. -3 would become +3, and +3 would become -3 etc.).

2.1.6 Questionnaires: To measure the personality traits and locus of control of participants we employed the Levenson locus of control questionnaire (Levenson 1972) and the Big Five Inventory 10 questionnaire, which is a validated and shorter 10-item version of the traditional Big Five questionnaire (Courtois et al. 2020).

2.1.7 Attention checks: To ensure that only trials where participants actually played the game were included, mouse-movement was tracked during each individual trial. If no movement was detected for a given trial, the trial was marked as a no-play trial and was discarded from analysis.

2.2 Results

We test for (1) trait-like predictors of sense of agency, and (2) trait-like predictors of belief alignment.

2.2.1 Model M1, trait predictors of sense of agency:

Model specifications:

Model M1: $logit(JoA\#1/7) = \beta_0 + \beta_1.InternalLoC + \beta_2.PowerfulOthersLoC + \beta_3.ChanceLoC + \beta_4.Extraversion + \beta_5.Agreeableness + \beta_6.Conscientousness + \beta_7.Neuroticism + \beta_8.Openness + y.Z + \varepsilon$

Where *initial judgment of agency* (JoA#1) is the dependent variable, *InternalLoC, PowerfulOthersloC* and *ChanceLoC* represent the three locus of control dimensions, *Extraversion, agreeableness, conscientiousness, neuroticism* and *openness* represent the big five personality traits, and $y.Z$ is the random term.

To test whether our trait-like constructs of interest were related to differences in sense of agency we conducted a logistic mixed model regression (N=529) (figure 3).

Hypothesis 1: Our findings show that internal locus of control is related to higher sense of agency (b = 0.002), SE < 0.001, t(519.5704) = 2.341, p = .02, 95% CI [0.0003, 0.0004]). In addition to this, we found that chance locus of control is related to a higher sense of agency (b = 0.001), SE < 0.001, t(519.4675) = 2.016, p = .04, 95% CI [0.0001, 0.0034].

Hypothesis 2: Interestingly, we did not find that any of the Big Five traits were related to higher sense of agency. In contrast to previous findings in the literature, our results do not corroborate the hypothesis that 'agreeableness', 'conscientiousness', 'extraversion', and 'openness' are related to higher sense of agency (p = 0.40, p = 0.09, p = 0.28, p = 0.78).

Hypothesis 3: Our findings also did not replicate previous findings that the Big Five trait 'neuroticism' was related to a higher sense of agency (p =.58).

2.2.2 Model M2, trait-like predictors of social alignment:

Model specifications:

Model M2:

$$logit(Alignment) = \beta_0 + \beta_1.InternalLoC + \beta_2.PowerfulOthersLoC + \beta_3.ChanceLoC + \beta_4.Extraversion + \beta_5.Agreeableness + \beta_6.Conscientousness + \beta_7.Neuroticism + \beta_8.Openness + y.Z + \varepsilon$$

Where *alignment* with disagreeing feedback is the dependent variable, *InternalLoC*, *PowerfulOthersloC* and *ChanceLoC* represent the three locus of control dimensions, *Extraversion, agreeableness, conscientiousness, neuroticism* and *openness* represent the big five personality traits, and *y.Z* is the random term.

To test whether our trait-like constructs of interest were related to differences in belief alignment we conducted a logistic mixed model regression (N=529) (figure 4).

Hypothesis 4: We found no evidence that higher internal locus of control was related to a lower proportion of alignment (p = .59).

Hypothesis 5: contrary to our hypothesis #2, we found no evidence that higher social-external, i.e. "powerful other", locus of control is related to a higher propensity to align with social feedback (p = .12).

Hypothesis 6: Lastly, our hypothesis #3, that predicted that the Big Five trait "agreeableness" is related to a higher likelihood to align with social feedback, was also not corroborated by the evidence (p = .58).

Bayes factor analysis was used to interpret the non-significant results of M4 (Dienes 2014), which showed substantial evidence in favor of the null hypothesis (BF < 0.33, *b* = 0.001, SE = 0.002, 95% CI = [-0.002, 0.003]).

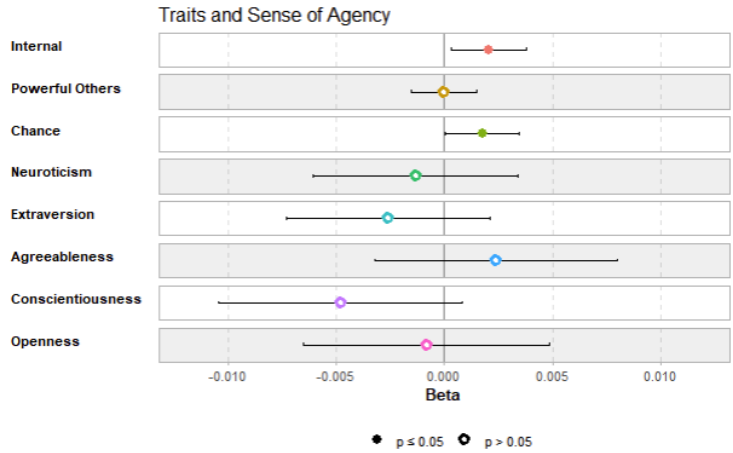

Figure 3: Predictors of JoA#1 (*M1*). Parameters with 95% confidence intervals from the logistic model of JoA #1.

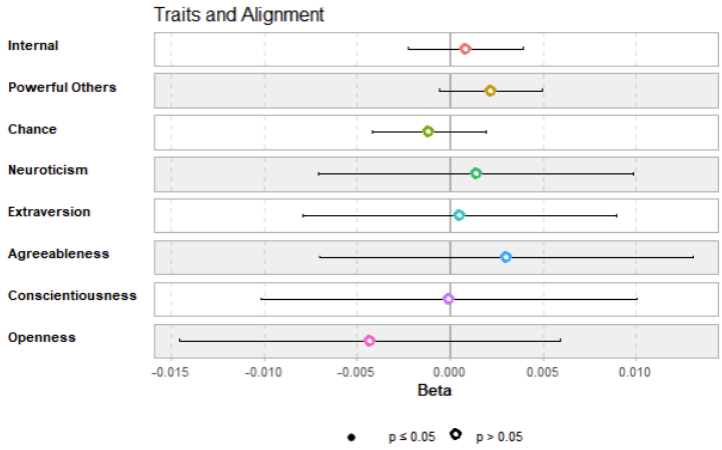

Figure 4: Predictors of belief alignment (*M2*). Parameters with 95% confidence intervals.

2.3 Discussion

The primary aim of this study was to investigate if personality traits can help explain individual differences in sense of agency and in how people integrate feedback from their peers in their agency judgments.

Our results (M1) show that some trait-like constructs capture a substantial portion of inter-individual variance in sense of agency. We found that internal locus of control is related to a higher sense of agency. This result is in line with previous findings and goes further in several respects (Dewez et al. 2019). Whereas previous studies show this effect in the context of body ownership in virtual reality settings, we here demonstrate the relationship between internal locus of control and sense of agency in a more abstract context with repeated measures for each participant. Crucially, we observed this effect in a much larger sample

than those previously tested in the literature which attests to the robustness.

Our results also show a relationship between chance locus of control and sense of agency. Surprisingly, we find in our data that chance locus of control is related to a *higher* sense of agency. We might instead expect chance locus of control to be related to a *lower* sense of agency, since external locus consists in seeing the mark of randomness in the occurrence of life events. One possible explanation for this counter-intuitive association is that chance locus of control captures beliefs about larger-scale events in the agent's *life* ("To a great extent my life is controlled by accidental happenings"), and our experimental paradigm here measures agency by asking the participant about a small-scale *object* in the agent's vicinity ("How much control do you think you had over The Catcher?"). Perhaps people who score high on the chance locus of control feel an exacerbated control over small-scale events because they can exert a direct physical, bodily influence on them, an influence they would no longer feel with distal large-scale life events.

Furthermore, unlike recent findings by Schwarz and collaborators (2022) we did not observe any significant relationship between sense of agency and the Big Five personality traits. A notable difference between the Schwarz et al. study and our own study is that we collected agency judgments on a trial-by-trial basis, whereas Schwarz et al. collected agency judgments once every 25th trial. Whereas we might capture a more 'state-dependent' sense of agency, Schwarz et al. might capture a more state-independent sense of agency. The very nature of such measure would make it more likely to correlate with the Big Five, which are thought to capture stable constructs relatively independent from the current state of the measurement context. Just like psychological variable of interest (eg., Safra et al. 2023), research on feelings of agency will benefit from future research programs that precisely attempt to capture its state-trait component, and understand how these components relate to real-life or task behaviors.

Our additional result (M2) did not confirm any of our hypotheses about the relationship between personality traits and susceptibility to social influence. In contrast to our hypotheses H3-H4, we did not find any evidence that either Internal or Powerful Others locus of control was related to alignment behavior. Nor did we find any evidence that the Big Five trait Agreeableness was related to social alignment (H6).

Instead, Bayes factor analysis show substantial evidence in favor of the null hypothesis, i.e. evidence in favor of the hypothesis that none of the personality traits played a role in explaining susceptibility to social influence in the context of agency judgments. These null findings are particularly interesting, because they are in direct contrast with studies that have previously shown a connection between the big five personality traits and social susceptibility (Jacquet et al. 2018, Oyibo & Vassileva 2019). One possible explanation of this contrast might be based on the type of judgment that is the target of social feedback. In our study, the target of the social feedback is the subjects' agency judgments. In the Oyibo & Vassileva study as well as the Jacquet et al. study, on the other hand, the judgments targeted by social feedback are initial decisions about how to act or how to score other people's trustworthiness from facial cues. Perhaps agency judgments are a special case of judgments that are not subject to the same processes underlying social susceptibility that are active in other contexts. Why should agency judgments be so special? It is possible that we are all aware of the fact that the accuracy of our agency judgments, more than the accuracy of other types of judgments, cannot be readily inferred from the outsider by observers. Something similar might be at play in our task, which implicitly assumes that the observer is capable of inferring the accuracy of the subjects' agency judgments from the mere visual cues of their actions on the game interface. In this precise context, this can have two consequences. First, it might make subjects simply more reluctant to revise their agency judgments in light of the observers' feedback. The second possible consequence is that in our task, subjects align to the social feedback for a different motive than subjects did in other studies. For instance, we cannot discern in current data whether participants are aligning for epistemic reasons or for reasons related to social desirability. The development of future lines of study is needed, first to clarify whether susceptibility to social influence is a domain-general or a domain-specific phenomenon and, secondly, to distinguish with a certain degree of precision between the various motives that can lead and individual to align or not align its own agency judgments.

2.4 Conclusion

All in all, our findings shed light on the relationship between sense of agency and personality traits, especially regarding the connection to locus of control. Our results also shed some light on the connection between personality traits and change of mind processes in the context of agency judgments. Specifically, our results show that none of the traits tested here appear to play a significant role in explaining inter-individual variance in change-of-mind behavior regarding one's own agency judgments. This suggests another direction must be explored to explain the inter-individual differences in social susceptibility in the context of agency. In general, the discrepancies between our results here and previous findings in the literature are puzzling and invite further investigations to explain these conflicting results. We have suggested several yet-unexplained directions for future research that could shed light on the connection between the personality traits tested here, sense of agency, and social susceptibility, in ways that could help untangle these ambiguous findings about the connection – or lack of same - between loci of control, Big Five personality traits, sense of agency, and social susceptibility.

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