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# Machiavelli as a poker mate — A naturalistic behavioural study on strategic deception

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ABSTRACT

Machiavellianism has been considered in the literature as the symbol for manipulative strategies in social conduct. However, it has been rarely studied via behavioural experiments outside the laboratory, in more naturalistic settings. We report the first behavioural study (N = 490) evaluating whether Machiavellian individuals, high Machs, deceive more than low Machs in online poker, where deception is ethically acceptable and strategically beneficial. Specifically, we evaluated Machiavellianism, bluffing patterns, and emotional sensitivity to getting "slow-played" ("stepping into a trap"). Bluffing was assessed by realistic poker tasks wherein participants made decisions to bluff or not, and sensitivity to slow-play by a self-report measure. We found that high Machs had higher average bluffsizes than low Machs (but not higher bluffing frequency) and were more distraught by getting slow-played. The Machiavellian sub-trait "desire for control" also positively predicted bluffing frequency. We show that online poker can be utilized to investigate the psychology of deception and Machiavellianism. The results also illustrate a conceptual link between unethical and ethical types of deception, as Machiavellianism is implicated in both.



## 1. Introduction

Deception refers to acts that propagate beliefs of things that are not true, or not the whole truth. It is an integral part of human behaviour, having co-evolved with cooperation when our ancestors manipulated the beliefs of others to obtain mates and resources, and to avoid direct conflicts (Cosmides & Tooby, 2005).

Some forms of human deception are considered to be more ethically acceptable than others, such as benign daily white lies (a lie in order *not* to hurt another person) compared with malicious large-scale frauds. However, regardless of their scale or form, acts of deception are often viewed in a negative light. Also most scientific research on human deception has focused on its "darker" side. For example, research on individual variation in deceptive behaviour has emphasized the role of the so-called "dark triad" personality traits — namely, psychopathy, narcissism, and Machiavellianism (e.g. Jones & Paulhus, 2011). Of these, Machiavellianism is particularly salient in deceptive behaviour: Individuals with high Machiavellianistic tendencies ("high Machs") engage in amoral and deceptive manipulation, tend to seek control over others and to gain status for themselves (Christie & Geis, 1970; Dahling, Whitaker, & Levy, 2009). High Machs view human nature in an overly cynical manner, and to them, the end often justifies the means.

More specifically, high Machs, compared with low Machs, have been found to be less ethical (Hegarty & Sims, 1978), better liars (Geis & Moon, 1981), more likely to cheat when the likelihood of getting caught is low (Cooper & Peterson, 1980), and more likely to engage in fraudulent financial reporting (Murphy, 2012). However, recently Jonason, Lyons, Baughman, and Vernon (2014) found that high Machs reported telling more lies (of any type) *and* white lies than low Machs, indicating that high Machs use deception strategically — not only due to lack of moral constraints.

This view of high Machs as *strategic* manipulators is consistent with the study by Jones and Paulhus (2011) evaluating the associations between impulsivity and the dark triad traits: whereas psychopathy and narcissism were associated with increased impulsivity, Machiavellianism was not, which the authors argued allowed "*Machiavellians to refrain from counterproductive behaviours despite their selfish intentions*". Along the same line, both psychopathy and Machiavellianism were found to be positively associated with cheating in university (e.g., plagiarism), but this association was weaker for Machiavellianism (Williams, Nathanson, & Paulhus, 2010). Ostensibly, lacking the impulsivity of psychopaths, high Machs more prudently attend to the possible negative consequences of cheating. According to this view, high Machs' deceptive and sometimes amoral tendencies are primarily driven by strategic calculations.

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To better understand the psychology of deception and Machiavellianism, it is worthwhile to evaluate the conceptual similarities and differences between socially condemnable and acceptable forms of deception. Although high Machs are more deceptive and manipulative in real life than low Machs, it is not well understood whether this tendency transfers to contexts where deception is not only morally acceptable but also strategically beneficial. If high Machs deceive and manipulate mainly for strategic reasons, they should be more likely than low Machs to deceive also in such morally acceptable contexts.

One way to shed light on this issue is to study how Machiavellianism influences behaviour in *economic games*, which allow evaluating various aspects of strategic decision-making. Unfortunately, not many such studies have been reported. In *trust games,*[2] high Machs were more likely than low Machs to distrust their co-players (Burks, Carpenter, & Verhoogen, 2003) and less likely to reciprocate trust (Bereczkei, Deak, Papp, Perlaki, & Orsi, 2013; Gunnthorsdottir, McCabe, & Smith, 2002). Spitzer, Fischbacher, Herrnberger, Grön, and Fehr (2007) found that when there was no fear of punishment for unfair resource allocations, high Machs defected more than low Machs. Finally, in the one-shot *ultimatum game*, high Machs behaved more "rationally" than low Machs by accepting unfair offers more frequently,[3] but resisted exploitation in the iterated version of the game (Meyer, 1992).

Most economic games entail some ecological validity concerns, being oversimplified for "laboratory-convenience". These games cannot fully model real-life behaviour. Previous studies have also not evaluated how Machiavellianism is linked to strategic deception in a naturalistic setting; it has been noted that tasks to induce deception in such settings are very challenging or even impossible to design (Book, Holden, Starzyk, Wasylkiw, & Edwards, 2006; Jonason et al., 2014).

*Poker* offers a platform for observing strategic deception in a naturalistic environment. Poker is played frequently by a hundred million people worldwide, most notably *online*. It is a game of incomplete information where some cards are known to the players only, but not to their opponents. No apparent ethical or social pressure prevents players from deceiving in poker; instead, deception is the norm in the game. Game-theoretically, deception is also *necessary* to increase winning chances (Chen & Ankenman, 2006). The most recognized form of deception in poker is *bluffing*, which refers to betting or raising (showing strength) with a weak hand (cf. glossary) to make the opponent fold (give up). Another form of poker deception is *slow-playing* (or *trapping*), which is roughly the opposite of bluffing: betting weakly or not at all with a very strong hand to "lure" the opponent into betting or raising with a weaker hand (luring someone into a trap). Both bluffing and slow-playing are strategies to increase the profitability of playing with weak (bluffing) or strong (slow-playing) poker hands by inducing a false belief in one's opponent about what cards the player is holding.

Moreover, unlike most other economic games, poker decision-making has direct monetary implications for the players, which can be mathematically calculated (e.g. Palomäki, Laakasuo, & Salmela, 2013). However, no previous study evaluated how individual differences in deceptive personality traits relate to these effects. The evidence linking Machiavellianism to strategic uses of deception (Jonason et al., 2014; Jones & Paulhus, 2011) suggests that individual differences in Machiavellianism might be reflected in different poker playing styles. If high Machs are strategic deceivers, they should be more likely than low Machs to bluff in online poker. We thus hypothesized that:

**H1a.** : High Machs bluff more frequently..

**H1b.** : Bluff in higher amounts than low Machs in online poker.

Similarly, Machiavellianism might be implicated also in slow-playing. In addition to being strategic deceivers, high Machs are sometimes referred to as true *homines economici* — rational and "cold-blooded" gamesmen whose decisions are mostly unaffected by emotions (Gunnthorsdottir et al., 2002). Thus, high Machs, compared with low Machs, might feel less distraught by losing due to being "slow-played" against, because they are better able to control their emotions. We also hypothesized that:

**H2.** : High Machs are less emotionally sensitive than low Machs to situations in which they are the victims of a slow-play.

## 2. Method

### 2.1. Participants

An online study including both behavioural and questionnaire-based measures was created with Qualtrics (www.qualtrics.com) in English. Five hundred and fifty-eight participants were recruited from various international online poker web-forums. Based on a priori criteria, 56 (10%) participants were screened out due to insufficient skills in written English (skills not reported as "very good or better"). Twelve participants (2.2%) were also omitted due to extreme values in one dependent variable.[4] The final sample size was 490 (424 [86.5%] males, 35 [7.1%] females, $M_{\text{age}} = 30.00$; $SD_{\text{age}} = 8.66$, range: 16–67). Gender imbalance is typical in studies sampling poker playing populations (Palomäki et al., 2013). Of the participants, 108 (22.9%) had no college education, 127 (27%) had some college education but no degree, 136 (28.9%) held a bachelor's degree, and 100 (21.3%) held a master's degree or higher. On average, our participants reported an annual income between US$30.000 and $40.000 (ranging from below $20.000 [35.1%] to above $80.000 [11.2%]). Thirty-one participants (6.3%) had missing data on demographics. These participants were omitted from analyses where demographic data was controlled for. Participants were offered the possibility of taking part in a draw of five separate $50 Amazon.com gift coupons. This study was approved by the Newcastle University ethics committee.

### 2.2. Procedure

Participants first gave informed consent. Thereafter they filled in the Machiavellian Personality Scale, and three exploratory measures (including measures of poker experience, and masculine traits such as competitiveness and assertiveness; consult the Supplementary material section for details), followed by behavioural bluffing tasks, a scale measuring sensitivity to slow-play, and demographics. Participants were to make *bet/do not bet* (i.e., bluff/do not bluff) decisions in four individual simulated bluffing tasks, in which they were "sitting" at an online poker table with four opponents represented by avatars and the names "Opponent 1–4" (see dependent variables).[5] The bluffing tasks were presented in random order.

### 2.3. Materials

#### 2.3.1. Machiavellian Personality Scale (MPS)

This 16-item scale conceptualizes Machiavellianism as individual propensity to distrust others, engage in amoral manipulation, and seek

[2] In two-player trust games, one player sends to the other some amount of resources, which are then multiplied by some factor and distributed at the receiver's discretion between the two players.

[3] In the one-shot ultimatum game, two players divide a sum of money between them. The first player proposes a division (e.g., 60–40), which the second player either accepts or rejects. If the proposal is rejected, neither player receives anything. If it is accepted, the money is split accordingly. Rejecting *any* offer can be viewed as "irrational", if assumed that receiving *some* resources is better than receiving *none*.

[4] Including these participants in the analyses *strengthened* the results.

[5] The study included also an experimental manipulation, where participants were randomly assigned across three conditions. The bluffing tasks were taken at a table with 1) gender mixed (two female and two male), 2) all male, or 3) all female avatar opponents. This manipulation was aimed at evaluating hypotheses unrelated to the current aims, and these results will be reported elsewhere. Including this manipulation into statistical models as a covariate/factor had no effect on the results presented in this paper.

control over others and status for oneself (Dahling et al., 2009). The MPS has 4 subscales, each including 3–5 items. All items are anchored from 1 ("completely disagree") to 7 ("completely agree"). The subscale labels are: *Amorality* ("I am willing to be unethical if I believe it will help me succeed"; $M = 2.69$, $SD = 1.13$, range = 1–6.2; Cronbach's $\alpha = .68$), *Desire for Control* ("I enjoy having control over other people"; $M = 4.31$, $SD = 1.30$, range = 1–7; Cronbach's $\alpha = .77$), *Desire for Status* ("Status is a good sign of success in life"; $M = 4.08$, $SD = 1.45$, range = 1–7; Cronbach's $\alpha = .82$), and *Distrust of Others* ("If I show any weakness at work, other people will take advantage of it"; $M = 3.05$, $SD = 1.14$, range = 1–6.4; Cronbach's $\alpha = .79$). The entire 16-item scale was normally distributed and had a satisfactory inter-item reliability ($M = 3.37$, $SD = 0.83$, range = 1–5.75; Cronbach's $\alpha = .85$).

We used the MPS instead of the more conventional Mach-IV scale (Christie & Geis, 1970). Studies employing Mach-IV have reported inconsistent scale reliabilities and dimensional structures for the instrument, but MPS showed promise in fixing these issues. Moreover, many of the items in the MPS have to do with striving for status and success, accumulating wealth, and enjoying having control over others. Such items (which the Mach-IV scale does not cover) are particularly salient for poker players: The stereotypical successful poker player has money and status, and less successful poker players strive to get there. Success in poker, in turn, requires manipulating others, or "controlling the action" (pulling the strings) in the game itself.

#### 2.3.2. Dependent variables

Three dependent variables (DVs) were employed in this study. Two DVs were behavioural measures of bluffing, and one DV was a questionnaire instrument to measure emotional sensitivity to slow-play.

*2.3.2.1. Bluffing measures.* Participants undertook four simulated online poker bluffing tasks involving the most popular poker variant, No Limit Texas Hold'em (NLHE). Participants first read detailed task instructions and indicated having understood them. In NLHE, an informed decision to bluff depends on the previous betting actions of one's opponents during a given hand (cf. glossary). We emulated typical betting sequences in online NLHE games for five players by presenting each task as an animated sequence of automated betting actions beginning *pre-flop*, and ending *on the river* (cf. glossary), upon which participants made a decision to either *bet* or *check*. See http://www.comp.lancs.ac.uk/~yanj2/poker/ for all betting sequence animations as they were presented to participants. We consulted professional poker players to ensure that the betting sequences were as realistic as possible for online NLHE. We closely emulated the graphical outlook of the tables used by the most popular online poker site, www.pokerstars.net. See the Supplementary material section for further details.

Participants made one decision against each opponent, and each decision was made in a *heads-up* situation (one versus one; the other three opponents had folded their cards and were not "in the hand"). If the participant decided to bet, s/he first indicated the amount to bet, and then whether or not the bet was a *bluff* ("Was your bet a bluff?" 1: "Yes", 2: "No", 3: "I don't know").[6] To reduce unwanted noise in the data, only the bets that participants reported to be bluffs were analyzed as actual bluffing decisions. However, in each task, at the time of betting, the participant's hand was so weak it would typically not make sense to bet unless it was to bluff.

Two DVs were calculated to assess the following questions. 1: How *frequently* do participants bluff? 2: If participants decide to bluff, what is their average *bluffsize*? The first DV was labelled *Bluffing Frequency* and calculated as the total number of bluffing decisions (range = 0–4) divided by four ($M = 0.45$, $SD = 0.23$, range = 0–1). The second DV was labelled *Average Bluffsize* and calculated as the total size of the bluffs divided by the total number of bluffing decisions ($M = 202$, $SD = 64.7$, range = 20–455). For Average Bluffsize, values of zero were not included in the analyses, since participants whose average bluffsize was zero (n = 38) did not make any decisions to bluff (this also normalized the variable distribution). Thus, in subsequent analyses the sample sizes for Average Bluffsize and Bluffing Frequency are different.

*2.3.2.2. Sensitivity to slow-play.* This scale was developed for the current study. It measures the extent to which individuals experience negative emotions in poker when they lose after being slow-played against. In other words, it measures emotional sensitivity to "getting slow-played". The scale consists of 3 items anchored from 1 ("completely disagree") to 7 ("completely agree"). The items are: 1) "*If I get slow-played and lose, I feel my opponent is playing 'dirty'*"; 2) "*If I get slow-played and lose, I feel angry*"; and 3) "*If I get slow-played and lose, I feel exploited*". The scale had an acceptable inter-item reliability ($M = 2.48$, $SD = 1.36$, range = 1–7; Cronbach's $\alpha = .69$).

The model residuals were heteroscedastic in the analyses with Bluffing Frequency or Sensitivity to slow-play as the DV. Thus, we employed heteroscedasticity-consistent standard error estimators in OLS regression (Hayes & Cai, 2007).

## 3. Results

H1a and H1b were tested by employing multiple regression to assess the associations between Machiavellianism and bluffing. Machiavellianism was positively associated with average bluffsize (B = 11.36, $t(450) = 3.1$, 95% CI [4.17, 18.5], $p = .002$, adj. $R^2 = .019$; controlled for demographics: B = 7.86, $t(415) = 2.1$, 95% CI [0.32, 15.4], $p = .041$, adj. $R^2 = .059$), but not with bluffing frequency (B = 0.01, $t(488) = 0.971$, $p$ = ns). Thus, H1b was supported (high Machs exhibited higher bluffsizes than low Machs), but H1a was not.

We also entered the four MPS subscales in two multiple regression models, predicting both DVs separately, controlling for demographics. Both models were statistically significant (average bluffsize: $F(8, 412) = 4.53$, $p < .001$, adj. $R^2 = .063$; bluffing frequency: $F(8, 450) = 8.26$, $p < .001$, adj. $R^2 = .11$). However, only two of the four MPS subscales were implicated in bluffing: Desire for control positively predicted bluffing frequency (B = 0.028, 95% CI [0.01, 0.05], $p = .002$), and distrust of others positively predicted average bluffsize (B = 7.12, 95% CI [1.29, 12.9], $p = .017$; cf. Table 1).

**Table 1**
Multiple regression analyses predicting bluffing behaviour. Analyses are presented separately for two DVs: Bluffing Frequency and Average Bluffsize ($). Hypothesis-relevant cells are highlighted.

| | DV: Bluffing Frequency (N = 458) | | | DV: Average Bluffsize (N = 420) | | |
|---|---|---|---|---|---|---|
| Variable | B | *t* | *p* | B | *t* | *p* |
| Constant | 0.796 | | | 287.69 | | |
| Distrust of others | −0.012 | −1.23 | ns | 7.12 | 2.40 | .017 |
| Desire for status | −0.005 | −0.59 | ns | −1.67 | −0.73 | ns |
| Desire for control | 0.028 | 3.11 | .002 | 0.55 | 0.20 | ns |
| Amorality | −0.013 | −1.24 | ns | 2.90 | 0.95 | ns |
| Age | −0.003 | −2.30 | .022 | −0.96 | −2.37 | .018 |
| Gender | −0.218 | −5.37 | <.001 | −47.90 | −3.40 | <.001 |
| Education | −0.012 | −1.29 | ns | −3.68 | −1.27 | ns |
| Income | 0.010 | 1.52 | ns | 1.92 | 1.0 | ns |
| *Adj. $R^2$* | .11 | | | .063 | | |
| *F* | 8.26 | | <.001 | 4.52 | | <.001 |

*Note.* Participants with missing data on demographics are omitted from the analyses. The model predicting Average Bluffsize does not include data from participants who did not bluff at all. Gender is calculated at male = 0 and female = 1.

[6] The only way to ascertain whether participants believed that they were bluffing or not was to ask them directly. The mechanics of the game do not allow for constructing bluffing scenarios where betting is "by definition" bluffing, because it is always possible that the player does not know if s/he is "betting to bluff" or not.

**Table 2**
Multiple regression analyses predicting sensitivity to slow-play.

| | DV: Sensitivity to slow–play (N = 458) | | |
|---|---|---|---|
| Variable | B | *t* | *p* |
| Constant | 2.37 | | |
| Distrust of others | 0.22 | 3.68 | <.001 |
| Desire for status | 0.07 | 1.43 | ns |
| Desire for control | 0.02 | 0.39 | ns |
| Amorality | 0.22 | 3.72 | <.001 |
| Age | 0.01 | 1.51 | ns |
| Gender | −0.06 | −0.24 | ns |
| Education | 0.01 | 0.20 | ns |
| Income | −0.07 | −1.91 | .057 |
| *Adj. $R^2$* | .11 | | |
| *F* | 7.68 | | <.001 |

*Note.* Participants with missing data on demographics are omitted from the analyses. Gender is calculated at male = 0 and female = 1.

H2 was tested by employing multiple regression to assess the associations between Machiavellianism and sensitivity to slow-play. Contrary to H2, Machiavellianism was *positively* associated with sensitivity to slow-play (controlling for demographics: B = 0.53, $t(453) = 7.05$, 95% CI [0.38, 0.68], $p < .001$, adj. $R^2 = .10$): High Machs reported feeling *more* distraught than low Machs by getting slow-played.

Again, we entered the four MPS subscales separately in a multiple regression model, predicting sensitivity to slow-play while controlling for demographics. The model was statistically significant ($F(8, 450) = 7.68$, $p < .001$, adj. $R^2 = .11$). Two MPS subscales positively predicted sensitivity to slow-play: distrust of others (B = 0.22, $t(450) = 3.69$, 95% CI [0.10, 0.34], $p < .001$) and amorality (B = 0.22, $t(450) = 3.72$, 95% CI [0.11, 0.34], $p < .001$), see Table 2.

## 4. Discussion

We assessed the association between trait Machiavellianism and ethically acceptable forms of strategic deception using poker as an instrument. The results showed that Machiavellianism (as measured by MPS) and its subscales were implicated in both bluffing frequency and average bluffsizes, and also in emotional sensitivity to getting slow-played.

### 4.1. Machiavellianism and bluffing

Higher scores in MPS predisposed participants to bluff in higher average sizes but not in higher frequency. When the MPS subscales were analyzed separately, only the subscale "distrust of others" positively predicted average bluffsize, but "desire for control" positively predicted also bluffing frequency.

In the MPS, desire for control relates to how much individuals enjoy giving the orders and having control in interpersonal situations. Distrust of others, in turn, relates to the propensity of not wanting to show weakness, and of taking advantage of weakness displayed by others. General poker strategy advises against showing weakness in the game, because it can be easily exploited, and bluffing is sometimes referred to as a means to "control the action" (Sklansky, 1999). One way to show weakness in poker is to consistently bet in small amounts (making "weak" bets instead of "strong" ones). Likewise, bluffing in too small amounts can be viewed as a weak and exploitable strategy, because it is mathematically more reasonable for opponents to call down small bets than large ones. Therefore, the links between desire for control and bluffing frequency on the one hand, and distrust of others and average bluffsize on the other hand are sensible.

### 4.2. Machiavellianism and sensitivity to slow-play

Slow-playing involves calling multiple bets to "lure" opponents into a trap, whereas bluffing involves only one decision to either bluff or not. A behavioural slow-playing task would be difficult to keep identical across subjects, and thus too complex to be implemented in an online study. Instead, for simplicity, we evaluated one single aspect of slow-playing, namely, emotional sensitivity to slow-play by employing a novel but unvalidated self-report instrument.

Contrary to our hypothesis, high Machs were *more* emotionally sensitive than low Machs to getting slow-played, with the MPS subscales "distrust of others" and "amorality" being most saliently implicated. Interestingly, "amorality" positively predicted sensitivity to slow-play, but not bluffing behaviour: participants' self-reported propensity to act amorally increased their likelihood of feeling distraught by being the target of a slow-play. Bluffing is an *act* of deception, whereas getting slow-played is *being the target* of deception. Acting deceptively in poker is unlikely considered unethical by the players, given that deception is the norm. However, being the target of deception might trigger negative feelings of being exploited or manipulated, and these feelings seem to be more pronounced in individuals who have a disposition for amoral behaviour.

### 4.3. Significance of findings, future studies and conclusions

In a seminal paper, Wilson, Near, and Miller (1996) called attention to building a more cohesive conceptual framework around Machiavellianism. According to them, "*Machiavellianism has become the symbol for manipulative strategies of social conduct, but the psychological literature on Machiavellianism has not done justice to the importance of the subject, in part because it lacks a conceptual framework for guiding empirical research.*" Significant progress has since been made, but many questions are still unanswered. For example, only a few studies have evaluated how Machiavellianism affects actual decision-making behaviour in economic games (Gunnthorsdottir et al., 2002; Meyer, 1992), and none of them have evaluated how Machiavellianism affects strategic deception in a naturalistic environment.

Findings from studies employing economic games (Bereczkei et al., 2013; Burks et al., 2003; Meyer, 1992; Spitzer et al., 2007) suggest that high Machs are more prone than low Machs to engage in "emotionless" ("rational") deliberation to assess the pros and cons of manipulation and deception from a self-interested perspective. Due to this, high Machs have been dubbed as true *homines economici* — gamesmen who strategically aim to maximize their profits, often at the expense of others (Gunnthorsdottir et al., 2002). In a similar vein, to be a successful poker player, a general advice is to be the one controlling the action by being fearless and forcing your opponents to make the tough decisions (Sklansky, 1999). Perhaps high Machs are prone to engage in both ethical and unethical deception but for different reasons: High Machs might have an increased propensity to bluff *not* because they are amoral or desire status in life (which are implicated in unethical deception), but because they dislike showing weakness, and generally desire to be in control — traits fit for "true gamesmen".

Although high Machs have typically been considered to be more "cold-blooded" than low Machs (Wilson et al., 1996), our results indicate that – contrary to the hypothesis – in situations where high Machs get slow-played this pattern is reversed. For high Machs, being the target of manipulation seems to elicit strong negative emotions. If using deception in poker is viewed as a display of strength, then being manipulated by it might signal weakness. High Machs generally like to feel in control and dislike showing weakness, and might thus be prone to feeling distraught when someone else displays control over them —

that is, when someone makes them look weak and exploitable by using their own weapon against them.

Due to these unexpected findings, we performed *post-hoc* analyses by correlating our participants' scores on MPS, sensitivity to slow-play and two exploratory instruments; one measuring emotional sensitivity to poker losses (Sensitivity to Losses scale; Palomäki, Laakasuo, & Salmela, 2014) and the other measuring competitiveness. These measures were not directly related to poker deception and thus not pertinent to our hypotheses a priori, but we looked into them for alternative explanations.

Firstly, it is possible that high Machs are generally more competitive than low Machs and thus dislike being slow-played (or "out-played"). However, this hypothesis was not supported: Controlling for participants' self-reported level of competitiveness did not affect the results (cf. the Supplementary material section, Table S3).

Second, recent evidence has questioned the view of high Machs as cold-blooded individuals. For example, Szijjarto and Bereczkei (2015) reported that high Machs were less emotionally stable than low Machs, having a tendency of losing their coolness in some situations. High Machs have also been reported having trouble in subtly expressing their own emotions and empathizing with others (Ali & Chamorro-Premuzic, 2010; Szijjarto & Bereczkei, 2015). In fact, such deficits might make it easier for high Machs to deceive others: it is possible that high Machs experience strong emotions frequently, but manage to conceal these emotions from others due to being unable to express and share them (McIlwain, 2003). In line with these studies, we observed a positive correlation between sensitivity to (poker) losses and Machiavellianism: losing in poker was emotionally more stressful to high Machs than low Machs (cf. the Supplementary material section, Table S4). Consequently, an interesting venue for future research is to evaluate whether being the target of a successful *bluff* elicits strong emotional reactions from high Mach players. This could happen when a player bluffs an opponent and provocatively *shows* the bluff afterwards ("bluffing-and-showing").

Our results are also in line with the findings by Jonason et al. (2014) showing that Machiavellianism is partly characterized by the use of strategic deception, such as telling white lies, which is different from deceiving out of spite or due to lack of ethical consideration. Although white lies and bluffing in poker are very different types of deception, they might share a conceptual link via "desire for control". Moreover, employing a behavioural measure instead of a self-report one makes our study unique, and our results further complement the previous findings by extending their implications.[7] Future studies should test the hypothesis that high Machs are primarily motivated to tell non-malicious lies not because of empathy, but rather due to a desire to control the situation and due to a strategic evaluation of the benefits of lying.

Our study faces limitations. Because the study was performed online, we were unable to control for distractions participants might have faced. Our participants were mostly male, which limits our ability to generalize the results to a non-poker playing population. However, our sample was diverse in terms of education, income and age, which may not be the case in typical psychological studies sampling primarily student populations (and often within a single university). In the bluffing task, participants also did not play an actual poker game or wage their own money, which reduces ecological validity. Nonetheless, we mitigated these limitations by emulating an online poker environment used by the most popular online poker site (www.pokerstars.net), thus ensuring the highest possible ecological validity achievable in such experiments. Also the feedback from our participants was positive: many of them regarded our tasks as both highly realistic and easy to understand.

In conclusion, we are the first to show that online poker can be used as a naturalistic behavioural tool to better understand the psychology of strategic deception, which had previously proven to be a hard task in research on Machiavellianism. Given that human acts of deception are frequent and not always malicious, understanding why and when we deceive is important. To this end, deception should be evaluated from both unethical and ethical perspectives.

Our results illustrate a conceptual link between unethical and ethical deception via Machiavellianism. Of particular interest is the Machiavellian subtrait "desire for control", which could be a relevant factor in explaining high Machs' increased propensity for strategic deception. In poker, deception is a means to control the action — to make sure you are the one in charge. This contention has also wider implications in offline settings beyond poker. For example, desire for control might be the reason why high Machs tell white lies frequently in interpersonal relationships, possibly to avoid quarrels. This illustrates one way, but not the only way, whereby our current findings in poker extend to a real-world non-poker context.

## Acknowledgments

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## Appendix A. Supplementary data

Supplementary data to this article can be found online at http://dx.doi.org/10.1016/j.paid.2016.03.089.

## References

Ali, F., & Chamorro-Premuzic, T. (2010). Investigating theory of mind deficits in nonclinical psychopathy and Machiavellianism. *Personality and Individual Differences*, *49*(3), 169–174.

Bereczkei, T., Deak, A., Papp, P., Perlaki, G., & Orsi, G. (2013). Neural correlates of Machiavellian strategies in a social dilemma task. *Brain and Cognition*, *82*(1), 108–116.

Book, A. S., Holden, R. R., Starzyk, K. B., Wasylkiw, L., & Edwards, M. J. (2006). Psychopathic traits and experimentally induced deception in self-report assessment. *Personality and Individual Differences*, *41*(4), 601–608.

Burks, S. V., Carpenter, J. P., & Verhoogen, E. (2003). Playing both roles in the trust game. *Journal of Economic Behavior & Organization*, *51*(2), 195–216.

Chen, B., & Ankenman, J. (2006). *The mathematics of poker.* Pittsburgh: Conjelco.

Christie, R., & Geis, F. (1970). *Studies in Machiavellianism.* San Diego, CA: Academic Press.

Cooper, S., & Peterson, C. (1980). Machiavellianism and spontaneous cheating in competition. *Journal of Research in Personality*, *14*(1), 70–75.

Cosmides, L., & Tooby, J. (2005). Neurocognitive adaptations designed for social exchange. In D. M. Buss (Ed.), *The handbook of evolutionary psychology* (pp. 584–627). New Jersey: John Wiley & Sons.

Dahling, J. J., Whitaker, B. G., & Levy, P. E. (2009). The development and validation of a new Machiavellianism scale. *Journal of Management*, *35*(2), 219–257.

Geis, F. L., & Moon, T. H. (1981). Machiavellianism and deception. *Journal of Personality and Social Psychology*, *41*(4), 766–775.

Gunnthorsdottir, A., McCabe, K., & Smith, V. (2002). Using the Machiavellianism instrument to predict trustworthiness in a bargaining game. *Journal of Economic Psychology*, *23*(1), 49–66.

Hayes, A. F., & Cai, L. (2007). Using heteroscedasticity-consistent standard error estimators in OLS regression: An introduction and software implementation. *Behavior Research Methods*, *39*, 709–722.

Hegarty, W. H., & Sims, H. P. (1978). Some determinants of unethical decision behavior: Experiment. *Journal of Applied Psychology*, *63*(4), 451–457.

[7] Unlike white lies, poker deception has direct real world monetary implications. In the Supplementary material section, we have provided theoretical expected monetary value calculations based on bluffing frequency and size. These give an outline for how specific types of personality characteristics might have actual monetary implications in a real life context.

Jonason, P. K., Lyons, M., Baughman, H. M., & Vernon, P. A. (2014). What a tangled web we weave: The Dark Triad traits and deception. *Personality and Individual Differences*, *70*, 117–119.

Jones, D. N., & Paulhus, D. L. (2011). The role of impulsivity in the Dark Triad of personality. *Personality and Individual Differences*, *51*(5), 679–682.

McIlwain, D. (2003). *Bypassing empathy: A Machiavellian theory of mind and sneaky power.* New York: Psychology Press.

Meyer, H. D. (1992). Norms and self-interest in ultimatum bargaining: The prince's prudence. *Journal of Economic Psychology*, *13*(2), 215–232.

Murphy, P. R. (2012). Attitude, Machiavellianism and the rationalization of misreporting. *Accounting, Organizations and Society*, *37*(4), 242–259.

Palomäki, J., Laakasuo, M., & Salmela, M. (2013). "Don't worry, it's just poker!"—Experience, self-rumination and self-reflection as determinants of decision-making in on-line poker. *Journal of Gambling Studies*, *29*(3), 491–505.

Palomäki, J., Laakasuo, M., & Salmela, M. (2014). Losing more by losing it: Poker experience, sensitivity to losses and tilting severity. *Journal of Gambling Studies*, *30*(1), 187–200.

Sklansky, D. (1999). *The theory of poker.* Henderson, NV: Two Plus Two Publishing LLC.

Spitzer, M., Fischbacher, U., Herrnberger, B., Grön, G., & Fehr, E. (2007). The neural signature of social norm compliance. *Neuron*, *56*(1), 185–196.

Szijjarto, L., & Bereczkei, T. (2015). The Machiavellians' "Cool Syndrome": They experience intensive feelings but have difficulties in expressing their emotions. *Current Psychology*, *34*(2), 363–375.

Williams, K. M., Nathanson, C., & Paulhus, D. L. (2010). Identifying and profiling scholastic cheaters: Their personality, cognitive ability, and motivation. *Journal of Experimental Psychology: Applied*, *16*(3), 293–307.

Wilson, D. S., Near, D., & Miller, R. R. (1996). Machiavellianism: A synthesis of the evolutionary and psychological literatures. *Psychological Bulletin*, *119*(2), 285–299.

# Supplementary Materials (Machiavelli as a Poker Mate)

## 1. Glossary

| | |
|---|---|
| **Poker Hand** | Depending on the context, a Hold'em poker hand may refer to either **1)** a single round of game play; the period beginning when cards are dealt and ending with the showdown (revealing of players' cards and deciding the winner of a given hand), **2)** the two cards dealt to each player at the beginning of each round of game play (also referred to as the starting hand or hole cards), or **3)** the best five-card combination that can be formed using the hole cards and the community cards. Use of the term "hand" in this article refers to definition **1**. |
| **NLHE** | No Limit Texas Hold'em – A popular variation of the standard game of poker. Any game of poker is a card game involving betting whereby the winner is determined based on the ranking of their cards. NLHE consists of two cards being dealt face down to each player, and then five community cards – cards that can be used by all players – being placed face-up. Players have the option to **check**, **call**, **bet**, **raise**, or **fold** either prior to the flop (**pre-flop**), on the **flop**, on the **turn**, and on the **river**. |
| **Blinds** | Forced bets (small and big blind) that are placed into the **pot** by players before play begins |
| **Button** | The **(dealer) button** is a marker used to indicate the player who acts last on that deal. |
| **Pre-flop** | The period beginning with the dealing of cards and ending with the **flop** in Hold'em poker |
| **Flop** | The first three cards dealt face-up to the board in Hold'em poker |
| **Turn** | The fourth card dealt face-up to the board in Hold'em poker |
| **River** | The fifth and final card dealt face-up to the board in Hold'em poker |
| **Pot** | Sum of money (or chips) that players have waged during a single **hand** (definition **1**) of game play |
| **Bet** | To wager an initial amount of money |
| **Fold** | To discard one's cards and give up playing during the current **hand** (definition **1**), thereby forfeiting interest in the current **pot** |
| **Check** | Declining to make a **bet**, but retaining the right to **call** or **raise** bets or raises made by subsequent players |

**Call** Matching a **bet** or a **raise** made by another player

**Raise** Increasing the size of a **bet** required to stay in the pot, forcing all subsequent players to call the new amount (or raise more) if they wish to remain in

**2. Bluffing task instructions**

The following instructions were shown to the participants:

**“**Please read these instructions carefully!

On the next pages, you will be shown four visual online poker scenarios, one per page. The game is No Limit Texas Hold’em, cash/ring game (not a tournament!), played at a table with 4 opponents and yourself (5 players in total). The opponents are represented by avatars.

The blinds are $5 and $10, and each player has $1000 at the beginning of each round. Four rounds (or “hands”) will be played in total.

Each round is automatically “played through” as frame-by-frame animated actions made by the players (including you!) at the table. **Please pay attention during this time, as you will not be shown the actions again!**

**You cannot influence these actions**, and you have to wait until the animation is finished – for each round, this will take about 80 seconds.

The animation finishes before the last possible action (“on the river”), and you will be asked to make a decision to either **1) CHECK, or 2) BET**. If you decide to BET, you will also be asked to write down the size (in numbers) of your bet.

Make your decision based only on the information provided on this page, and on the animations themselves. Play as you would normally online (even if you don't normally play with the current level of stakes), against otherwise "unknown" opponents.

Click on the arrow ">>" to continue to the first scenario!

Please indicate below that you have understood the above instructions.**”**

### 3. Textual descriptions of the poker tasks

**Task 1**

You are in the button position with **[6c 7c]** (six of clubs, seven of clubs), and the actions is folded to you (before the flop, the two players acting before you have folded). You "auto-bet" $25, the small blind folds, and the big blind calls. The pot is $55, and the game is "heads-up" (one versus one). The flop is **[5c 8c Jh]** (five of clubs, eight of clubs, jack of hearts), and the opponent checks. You "auto-bet" $40, and the opponent calls. The pot is $135. The turn is **[Qd]** (queen of diamonds), and the opponent checks. You "auto-bet" $90, and the opponent calls. The pot is $315. The river is **[Ad]** (ace of diamonds). The opponent checks.
The board is now **[5c 8c Jh][Qd][Ad]**, the pot is $315, and you are holding **[6c 7c]**. Do you check or bet?

**Task 2**

You are in the big blind position with **[8s 9s]** (eight of spades, nine of spades). Before your turn to act, three opponents call the big blind of $10, and the opponent in the small blind position raises to $30. You "auto-reraise" to $130. Three opponents fold, and the opponent in the small blind position calls. The pot is $290, and the game is "heads-up" (one versus one). The flop is **[2d Jd 6d]** (two of diamonds, jack of diamonds, six of diamonds), and the opponent checks. You "auto-check". The turn is **[3d]** (three of diamonds), and the opponent checks. You "auto-check". The river is **[Qh]** (queen of hearts), and the opponent checks.
The board is now **[2d Jd 6d][3d][Qh]**, the pot is $290, and you are holding **[8s 9s]**. Do you check or bet?

**Task 3**

You are in the button position with **[Ac 6s]** (ace of clubs, six of spades). Before your turn to act, two opponents call the big blind of $10. You "auto-raise" to $50, the opponent in the small blind calls, and the two other opponents (who called $10) fold. The pot is $130, and the game is "heads-up" (one versus one). The flop is **[Ks Tc Qh]** (king of spades, ten of clubs, queen of hearts), and the opponent checks. You "auto-bet" $90, and the opponent calls. The pot is $310. The turn is **[2h]** (two of hearts), and the opponent checks. You "auto-check". The river is **[9h]** (nine of hearts), and the opponent checks.
The board is now **[Ks Tc Qh][2h][9h]**, the pot is $310, and you are holding **[Ac 6s]**. Do you check or bet?

**Task 4**

You are in the button position with **[2s 2c]** (two of spades, two of clubs). Before your turn to act, the opponent who is first to act raises to $50, one opponent folds, and you "auto-call" the bet of $50. The opponents in the small and big blinds fold. The pot is $115, and the game is "heads-up" (one versus one). The flop is **[7h Th 9s]** (seven of hearts, ten of hearts, nine of spades), and the opponent checks. You "auto-bet" $90, and the opponent calls. The pot is $295. The turn is **[3h]** (three of hearts), and the opponent checks. You "auto-check". The river is **[Jc]** (jack of clubs), and the opponent checks.
The board is now **[7h Th 9s][3h][Jc]**, the pot is $295, and you are holding **[2s 2c]**. Do you check or bet?

**4. Further details on the poker tasks**

Below, we first briefly introduce the rules of NLHE, and then explain how our bluffing tasks were constructed.

In NHLE, two cards are first dealt face down to each player, followed by a round of betting (period called *pre-flop*). Then, five community cards that can be used by all players are placed face-up on the table. The first three community cards are called the *flop*, and the last two cards the *turn* and *river*, and there is a round of betting after each. This period of play beginning with pre-flop and ending at latest on the river is called a *hand*.

During a NLHE hand, players have multiple opportunities to bluff during pre-flop, on the flop, turn, and river (also known as *streets*). Bluffs on the river almost always end the hand (they are either called down or folded against[1]), whereas bluffs on other streets are sometimes followed by another round of betting (if a bluff on the turn is called, another round of betting takes place on the river). For simplicity, participants in our experiment bluffed only on the river.

In order to make an informed bluffing decision on the river, it is highly important for players to know what the opponents' preceding betting actions were. A realistic bluffing task needs to give participants this information. We accomplished this by presenting each task as an animated sequence of "automated" betting actions beginning pre-flop, and ending on the river, upon which participants decided to either *bet* or *check.* Participants could not influence these automated actions. We took special care in emulating typical betting actions observed in online NLHE games for five players: We consulted professional poker players to make sure the betting actions were as realistic as possible.

The opponents (avatars) and the participant were "sitting" in the same table position across the four tasks. Participants made one decision against each opponent, and each

[1] A bluff on the river might get *raised*, but in these cases the bluffer almost always gives up and folds.

decision was made in a *heads-up* situation (one versus one; the other three opponents had folded their cards and were not "in the hand").

**5. Additional analyses**

Table S1. *Pearson correlations (two-tailed) between the Machiavellian Personality Scale subscale "distrust of others" items, and Average bluffsize (one of the three dependent variables used in the study).*

| **Variable** | 1. | 2. | 3. | 4. | 5. | 6. |
|---|---|---|---|---|---|---|
| 1. People are only motivated by personal gain | 1 | .30*** | .37*** | .32*** | .35*** | .08[a] |
| 2. I dislike committing to groups because I don't trust others | | 1 | .51*** | .35*** | .44*** | .12* |
| 3. Team members backstab each other all the time to get ahead | | | 1 | .52*** | .46*** | .09[a] |
| 4. If I show any weakness at work, other people will take advantage of it | | | | 1 | .61*** | .19*** |
| 5. Other people are always planning ways to take advantage of the situation at my expense | | | | | 1 | .13** |
| 6. Average bluffsize (DV) | | | | | | 1 |

*Note:* N=452. *a*: *p*.<.1; * : *p*.< .05; **: *p*.< .01; ***: *p*.<.001; Hypothesis-relevant cells are highlighted (see main text).

Table S2. *Pearson correlations (two-tailed) between the Machiavellian Personality Scale subscale "desire for control" items, and Bluffing frequency (one of the three dependent variables used in the study).*

| **Variable** | 1. | 2. | 3. | 4. |
|---|---|---|---|---|
| 1. I like to give the orders in interpersonal situations | 1 | .63*** | .42*** | .12** |
| 2. I enjoy having control over other people | | 1 | .49*** | .14** |
| 3. I enjoy being able to control the situation | | | 1 | .11* |
| 4. Bluffing frequency (DV) | | | | 1 |

*Note* *: *p*.< .05; **: *p*.< .01; ***: *p*.<.001; Hypothesis-relevant cells are highlighted (see main text).

Table S3. *Summary of multiple regression analyses predicting sensitivity to slow-play, and controlling for self-reported level of Competitiveness.*

| | DV: Sensitivity to slow-play (N=458) | | |
|---|---|---|---|
| **Variable** | B | *t* | *p* |
| Constant | 2.77 | | |
| Distrust of Others | 0.21 | 3.45 | <.001 |
| Desire for Status | 0.04 | 0.73 | ns |
| Desire for Control | 0.08 | 1.59 | ns |
| Amorality | 0.22 | 3.51 | <.001 |
| Competitiveness | -0.74 | -1.51 | ns |
| Age | 0.01 | 1.45 | ns |
| Gender | -0.06 | -0.23 | ns |
| Education | 0.01 | 0.06 | ns |
| Income | -0.06 | -1.50 | ns |
| *adj.* $R^2$ | .12 | | |
| *F* | 7.54 | | <.001 |

*Note.* Participants with missing data on demographics are omitted from the analyses. Gender is calculated at Male = 0, Female = 1. All other predictors are centered. “Competitiveness” is a self-report measure where the statement “I am competitive” was evaluated on Likert 1 “Never or almost never true” to 7 “Always or almost always true” scale. Heteroscedasticity-consistent standard error estimators in OLS regression (robust regression) are employed.

**5.1 Correlations between Sensitivity to losses, Sensitivity to slow-play, and MPS**

Sensitivity to Losses is an 11-item scale measures the extent to which poker players experience negative emotions (e.g., feelings of unfairness, anger and frustration) elicited by poker losses. Example items are: "I feel losing is unfair" and "When I lose, I feel anger". All items are anchored from 1 ("Completely disagree") to 7 ("Completely agree"). Higher scores indicate a higher tendency to experience negative emotions of, e.g., unfairness, anger and frustration elicited by losses.

*Source:* Palomäki, J., Laakasuo, M., & Salmela, M. (2014). Losing more by losing it: Poker experience, sensitivity to losses and tilting severity. *Journal of Gambling Studies*, *30*(1), 187-200.

Table S4. *Spearman correlations (two-tailed) between the Machiavellian Personality Scale, its subscales, Sensitivity to Slow-Play, and Sensitivity to Losses.*

| **Variable** | 1. | 2. | 3. | 4. | 5. | 6. | 7. |
|---|---|---|---|---|---|---|---|
| 1. Sensitivity to Slow-play | 1 | .42*** | .31*** | .25*** | .14** | .12** | .28*** |
| 2. Sensitivity to Losses | | 1 | .27*** | .24*** | .09* | .05 | .29*** |
| 3. MPS (full scale) | | | 1 | .67*** | .62*** | .58*** | .74*** |
| 4. Distrust of Others | | | | 1 | .19** | .14** | .32*** |
| 5. Desire for Status | | | | | 1 | .37*** | .28*** |
| 6. Desire for Control | | | | | | 1 | .31*** |
| 7. Amorality | | | | | | | 1 |

*Note* *: *p.*< .05; **: *p.*< .01; ***: *p.*<.001.

**5.2 Poker experience scale (PES)**

PES has been shown to predict mathematical accuracy in poker decision-making and has been used in several studies to measure players' level of poker skill and knowledge. Thus, we included PES as an exploratory variable (for complete coding and abbreviations of the original scale, see Palomäki, Laakasuo, & Salmela, 2013a). To reduce previously observed skewness in PES, we modified it slightly. In the current study, PES consisted of three 11-point and one 10-point Likert items: How many years have you played poker? (1 = Less than 0.5 [6 months]; 11 = More than 15); At what level of stakes do you usually play? (1 = No real money stakes, just for fun; 11 = Above NL600, PLO600, SNG500, MTT500); What is the rough estimate of how many poker hands you have played during your life? (1 = 0–10 000; 11 = more than 5 million); and Do you consider yourself to be a professional poker player? (1 = Definitely not a [full time] professional poker player; 10 = Definitely a [full time] professional poker player). The 4-item scale ($M$ = 5.23, $SD$ = 2.12, range = 1–10) was normally distributed and had a satisfactory inter-item reliability (Cronbach's $\alpha$ = .80). Higher scores on PES indicate higher level of poker experience and skill.

We observed an interaction between level of poker experience (as measured by PES) and desire for control (both predictors were centered) when predicting average bluffsize (B = -2.82, $t(448)$ = -2.62, $p$ = .009). Simple slopes analysis of this interaction showed that desire for control predisposed inexperienced poker players (PES values -1 SD below the mean) but *not* experienced ones (+1 SD) to bluff in higher average amounts. See Table S5 and Figure S1.

Table S5. *Full interaction model and simple slopes analysis for Desire for Control (MPS subscale), with Poker Experience Scale (PES) as the moderator and Average Bluffsize as the DV.*

| Variable | | | | Simple slopes when Poker Experience Scale (PES) is the moderator | | |
|---|---|---|---|---|---|---|
| | B | *t* | *p* | Slope | B | *p* |
| Constant | 201.25 | | | | | |
| Desire for Control | 2.32 | 0.99 | ns | -1 SD | 10.90 | .016 |
| PES | 6.20 | 4.31 | <.001 | +1 SD | -4.47 | ns |
| PES x Desire | -2.82 | -2.62 | .009 | | | |
| *adj.* $R^2$ | .054 | | | | | |
| *F* | 8.53 | | <.001 | | | |

*Note.* Unstandardized B-values are shown.

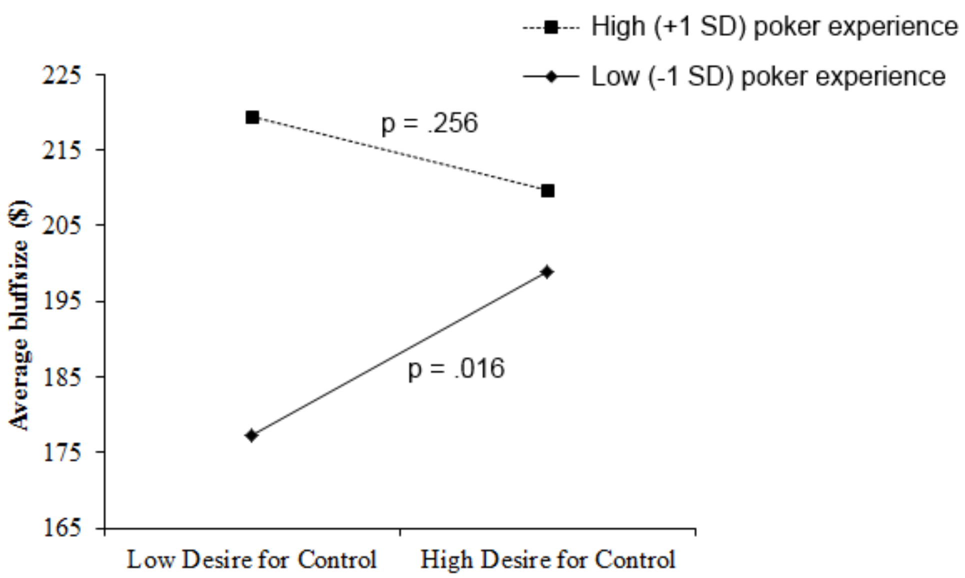


Figure S1. Association between Desire for Control (MPS subscale) and Average Bluffsize ($) in individuals with high (+1 SD) and low (-1 SD) poker experience (PES scores). See Table S5 for full statistics.

**6. Expected monetary value of bluffing**

In order to evaluate the monetary implications of individual differences in bluffing, we performed *post hoc* expected value calculations. These were made possible by having data on the participants' bluffing frequency and their average bluff sizes. Specifically, we calculated the expected value of calling the bluffs made by the participants – or, in other words, the monetary implications for the hypothetical *opponents* in our experiment. Below, for clarity, we will refer to the hypothetical opponent as "Player 1" and the participant as "Player 2".

We focus on the MPS subscale "Desire for control", since it was the strongest individual predictor of bluffing frequency[2]. In a simple regression model predicting Bluffing frequency with Desire for control, for every one unit increase in Desire for control (measured between 1 and 7), Bluffing frequency increases by 0.028 (with a constant value of 0.453, which represents the hypothetical value of Bluffing frequency when Desire for control equals 0). This increase is significant at $p = .002$ (95% bootstrapped CI: 0.013 – 0.043). In a similar model predicting Average bluffsize, for every one unit increase in Desire for control, Average bluffsize increases by 4.13 (with a constant value of 213.9), but this increase is not statistically significant, $p = .26$. Thus, in the calculations below, we treat the association between Desire for control and Average bluffsize as zero (i.e. not significant).

Across the four tasks, the average size of the pot (amount of contended money) on the river was \$301.7, and the average bluff size was \$213.9 (see above). Player 1 needs to call this amount for a potential gain (equaling the size of the pot before calling) of \$213.9 + \$301.7 = \$505.6. For simplicity, we make the following assumptions:

[2] For simplicity, we base these calculations on a statistical model where the DVs Average bluffsize and Bluffing frequency were separately predicted by "Desire for control" alone. Note that the trend or significance of the results is not affected by including demographic variables, or the experimental manipulation conditions (which were not focused on in the current article) in the model as covariates.

**1)** Generally, a bet on river (see Glossary) in online poker is either made as a bluff or "for value" (i.e. in hopes of getting called by a worse hand)

**2)** In actual online poker, in similar "river positions" as those used in our experiment, the player who is betting is typically equally likely to have a strong hand as a weak one, and very unlikely to have a hand of medium strength. Therefore, we assume Player 2 will have a strong hand (i.e. a winning hand) 50% of the time, and a weak hand (i.e. a losing hand) 50% of the time. Although this assumption is a simplification, it is based on the feedback from two professional poker players we have consulted. The exact distribution of hand strengths in similar river positions is impossible to ascertain, given the imperfect information nature of the game

**3)** In similar river positions as those used in our experiment, strong hands will always bet "for value" (i.e. they will never "check") and the bet sizes will be similar to those of the bluffs

Given these assumptions, we can extrapolate the results from the current experiment to actual online poker. Player 2 will have a winning hand 50% of the time, of which s/he will bet for value $P_{valuebet} = 1 = 100\%$ of the time and a losing hand 50% of the time, of which s/he will bet (i.e. bluff) $P_{bluff}$ of the time. To assess the monetary implications of bluffing between individuals with varying levels of Desire for control, we obtain the values of $P_{bluff}$ from our experimental observations: Average bluffing frequency increased by 0.028 (2.8%) for every one unit increase in Desire for control. Thus, the bluffing frequency of individuals with varying scores on Desire for control is:

$$P_{bluff} = [\text{Desire for control score}] \times 0.028 + 0.453$$ [3]

[3] Plus an error term, which we ignore here for simplicity.

The conditional probability of Player 2 bluffing knowing s/he has bet is:

**$P(A|B) = P($"*Player 2 bluffs*" | "*Player 2 bets*"$) = (0.5 \times P_{bluff}) / (0.5 \times P_{valuebet} + 0.5 \times P_{bluff})$**

If Player 2 scored high (e.g. 6/7) on Desire for control, the above yields:

**$(0.5 \times (6 \times 0.028 + 0.453)) / (0.5 \times 1 + 0.5 \times (6 \times 0.028 + 0.453)) =\sim 0.3831$**

Similarly, if Player 2 scored low (e.g. 2/7) on Desire for control, the above yields:

**$(0.5 \times (2 \times 0.028 + 0.453)) / (0.5 \times 1 + 0.5 \times (2 \times 0.028 + 0.453)) =\sim 0.3373$**

The expected monetary value of calling is:

**$P(A|B)$ x [Size of the pot before calling] – (1 – $P(A|B)$) x [Size of the bet]**

Against players with high (6/7) Desire for control, this yields:

**0.3831 x $505.6 – 0.6169 x $213.9 =~ $61.74**

Against players with low (2/7) Desire for control, this yields:

**0.3373 x $505.6 – 0.6627 x $213.9 =~ $28.79**

Thus, we estimate that calling the bets made by Player 2 would be **$61.74 – $28.79 =~ $33** more profitable *per bet* if said player scored high (i.e. 6/7) on Desire for control as compared with players who score low on the scale (2/7).

**6. Study covariate not analyzed**

**Masculinity Trait Index.** This 10-item scale measures one's own self-perceived "masculine" characteristics. Example items are: "I am competitive" and "I have leadership abilities". All items are anchored from 1 ("Completely disagree") to 7 ("Completely agree"). Higher scores indicate higher self-perceived masculinity.

*Source:* Stern, B. B., Barak, B., & Gould, S. J. (1987). Sexual identity scale: a new self-assessment measure. *Sex Roles*, *17*(9-10), 503-519.