Embodiment in Poker

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Abstract

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Embodiment can be identified by internal feelings or emotions taking physical form. The influences that trigger these feelings can be driven by a wide array of environmental factors. In the card game of poker, players attempt to hide their emotions and feelings, thus making it theoretically more difficult to recognize the embodiment of these thoughts. However, despite a player’s attempt to cover these physical forms, some cues of embodiment may be left unfiltered. A total of N=151 participants viewed a series of 10 clips of amateur poker players placing bets and rated each betting motion on a series of measures. The current study suggests that despite their conscious effort to mask physical forms of their feelings, the distance that players moved their hands predicted the strength of their cards. The rated distance of the players’ chips as they placed a bet did not significantly predict the players’ card strength. Despite suggestions from previous research, rated smoothness of players’ hands did not significantly predict the players’ card strength. Also, participants’ ratings of the player’s hand strength significantly and negatively predicted players’ card strength.
Introduction

In the card game of Texas Hold ‘em, two cards are dealt to each player at the beginning of each round. These “hole cards” are known to their owners, but other players are blind to them. They vary greatly in strength and players are unaware of how strong their position is in the game until they glance at their cards. While strong hands may excite players, a key component of the game involves hiding these feelings in order to prevent other players from predicting their hand strength. This may be physiologically difficult for players with stronger cards as the strength in cards naturally increases arousal (Yogo, Hama, Yogo, & Matsuyama, 1995). The literature demonstrates that internal feelings and thoughts can take physical form, although this embodiment may be unknown to the individual experiencing them. For example, Yogo and colleagues (1995) determined that emotional arousal causes a physical response of increased blood pressure. It is important to study this nonconscious phenomenon as it demonstrates the depth of influence one’s environment has over their actions. It is particularly interesting to look at the effects of embodiment in poker to determine if people can stop themselves from the embodiment of their thoughts.

It goes without saying that our environment influences our behavior in a wide array of ways. Colleagues and peers can influence job satisfaction (Rhodes, 2015), the weather could influence our health (Durkalec, Furgal, Skinner, & Sheldon, 2015), and our social environment could play a role in our personality type (Bian, Han, Zhou, Chen, & Gao, 2015). While such examples of environmental influence show linear and direct results of embodiment, several other examples demonstrate more sophisticated relationships in which the environment stimulates an emotion, or feeling, in an
individual, and this state is identifiable in the individual’s sensorimotor actions (Korner, Topolinski, & Strack, 2015). In poker, players that are dealt strong cards should stimulate cognition around these strengths, and in turn, these thoughts may be embodied and exposed in physical form.

There are a number of ways that a player’s embodied thoughts can be expressed through their play such as facial expressions, verbal communication, bet placing, and reactions of looking at one’s cards. Particularly, the strength of one’s hand may promote embodiment of strength that is detectable throughout a player’s gameplay. Slepian, Young, Rutchick, and Ambady determined that poker hands are predicted at chance when observing thin-sliced clips of poker players’ faces, and predictions of poker hands were better than chance when observing the arm motions they make when betting (Slepian, Young, Rutchick, & Ambady, 2013). In essence, something in the poker players’ arm motions reveals secrets while the players are placing their bets, despite their efforts to mask their card strength. Perhaps players with strong hands embody strength when dealt cards of higher value, and weakness when dealt cards of lower value and this can be depicted in their strong motor actions of placing bets.

**Embodiment:**

Current research has demonstrated that sensorimotor states are often engaged as a result of experiences with one’s surroundings (Winkielman & Kavanagh, 2013). Thoughts and mental states that can evoke physical gestures that can be detected and explained through embodied cognition. In other words, individuals think, feel, and act in certain ways as a result of their interaction with the environment. While embodiment can
be detected in a number of contexts, it is often unconscious (Masson, Bub, & Lavelle, 2013).

It is argued that embodiment may be an evolutionary adaptation (Ahlsén, 2008). Ahlsén (2008) demonstrates that embodiment is an essential component of human communication; gestures that are associated with speech contribute greatly to one’s ability to communicate efficiently. Similar importance of gestures of communication has been observed in patients with Alzheimer’s disease (De Scalzi, Rusted, & Oakhill, 2015).

It has been shown that cognitive states can influence our physical states through embodiment. In one study, participants were asked to generate words associated with pride or disappointment. In generating these disappointing words, participant’s posture height was decreased significantly more than when they generated positive words (Oosterwijk, Rotteveel, Fischer, & Hess, 2009). Similarly, researchers Michalak, Mischnat and Teismann (2014) manipulated either depressive or nondepressive states in participants by having them sit in a slouched (depressive) position, or an upright (nondepressive) position. While sitting in these positions participants were shown various words on a computer screen and asked to remember as many as they could. The participants sitting in a slouched position recalled significantly more depressive words than did the participants sitting upright suggesting that the participants embodied the cognition of sadness and they therefore were able to recall more of these words that related to their cognition more closely than the other words in the instance of their presentation (Michalak, Mischnat, & Teismann, 2014). The results of these two studies demonstrate that the effects of embodiment are not linear. A substantive form must be
present before a verbal form of the embodiment, and vice versa, demonstrating that the cognitive processes can be stimulated in multiple ways.

Another study evaluated individuals’ signature sizes in association with their self-perception. Participants were asked to sign their name, and were either assigned a positive self-perception task (subliminal conditioning task), or not. They were asked to sign their name again minutes later. Participants who were assigned a positive subliminal conditioning task had significantly larger increases of signature sizes than those who did not (Rawal, Harmer, Park, O’Sullivan, & Williams, 2014). This finding demonstrates how positive self-perception, and possibly confidence can take physical forms of larger physical movements, specifically through arm and hand movements. In poker, one’s confidence, or self-perception, in their hand strength may be embodied into physical form while they make gestures or movements. If confidence and self-perception can be embodied, as demonstrated by Rawal et. al, poker players may move their arm and hands further when placing their bets when they hold stronger hands.

Research on embodiment has also shown that physical actions trigger different self-reflection through embodiment. Parzuchowski and colleagues determined that participants who put their hand over their heart embodied the cognitive state of honesty; these participants were more likely to admit their lack of knowledge to particular subjects than when their hands were not over their hearts. These results showed the participants more trustworthy in both the perspective of others and of themselves (Parzuchowshi, Szymkow, Baryla, & Wojciszke, 2014). Moreover, researchers Leitan, Williams, and Murray (2015) demonstrated the embodiment of ‘healing’. In their study, half of their participants physically looked up; the other half did not. Both groups were
then asked to evaluate words that were either related to healing or not. The study found that those that had looked up embodied the cognition of healing, and thus responded faster to words related to healing. (Leitan, Williams, & Murray, 2015). The results of this study suggest that embodiment may be an abstract form of sensorimotor systems.

In their applied research, Cuddy and colleagues set to make individuals more confident through their posture (Cuddy, Wilmuth, Yap & Carney, 2015). They instructed participants to take either a power pose, taking as much space as possible by extending their bodies outward, or a low-power pose which entailed contracting their bodies inward. After their poses, the participants were asked to prepare interview speeches for a stressful job interview conducted by blind interviewers. The results revealed that those who were assigned a power pose were more likely to be hired by the interviewers than those who struck low-power poses. The researchers discuss the embodiment of confidence and positive self-perception which is a viral tool in the hiring process. The research was expanded from a study conducted in 2010 that demonstrated how power-posing increased feelings of power and testosterone and decreased levels of estrogen (Carney, Cuddy, & Yap, 2010). Low-power posing demonstrated opposite effects. This embodiment of power may be reciprocated in poker when a player is given a position of power or strength in the game through high valued cards.

Different interactions can elicit different sensorimotor changes. For instance, Glenberg and Kachak (2002) observed how interactions between an individual and the environment are associated with hand movements away from the body. Participants were told phrases in-person while hand motions were prominently moving towards the body or away from the body. The interpretation of these phrases were found to be
significantly different based on hand motion. Their research supports the possibility that human action in communication takes a physical representation through arm motion to and from the body. Irregular arm motions that convey different messages than what is being said can confuse the listener, suggesting that the sensory-motor acts that people engage in are depicted by others (Glenberg & Kaschak, 2002). In poker, anytime a player places a bet, they are physically moving their arm forward to extend the chips. Differences in the arm movements away from the body while betting may be representative of their hand strength.

Embodiment demonstrates how internal cognitive thought may take external, often physical form. As demonstrated throughout the literature, thoughts of strength, confidence, and positive self-perception cognition are embodied and shown through various measures. In poker, strong hands should also stimulate cognitive representations of strength, and thus are able to be captured through the players’ movements, particularly in their arms and hands. While poker players deliberately attempt to hide embodied cognition of strength and weakness, the arousal may dim the performance of masking, thus allowing the embodiment to be demonstrated though their play.

Other research explores the contingencies of this relationship between arousal and performance. Bargh and Cohen determined there is a relationship between arousal and performance such that higher arousal causes smoother kinematic characteristics of motion (Bargh & Cohen, 1978). In the case of poker performance, stronger hands result in higher arousal, thus making players’ masking more difficult for those holding stronger cards. Other research shines light on what factors may contribute to arousal. It has been shown that in order to reach peak performance, individuals must practice at the
same level of arousal (Movahedi, Sheikh, Bagherzadeh, Hemayattalab & Ashayri, 2007). In their research Movahedi and colleagues asked participants to practice shooting free throws for ten days and measured their arousal level on each day. While participants free throw skill was the same despite arousal levels, when tested at an arousal level different, either higher or lower, than those they were used to during their practice, performance was significantly worse than when arousal was the same as their practiced level. The more familiar a situation, therefore, the more arousal it will cause. As strong poker hands are much less common to be dealt than the large group of mediocre hands, these situations are less visited. Because these instances are less visited, the embodiment of strength may be more prominent and thus more difficult to hide.

Despite the various barriers that come as a result of arousal and anxiety, an essential skill of a player is to overcome these obstacles and mask their hand strength that may be provoked though the embodiment of their cognition. The literature highlights a number of factors that can improve masking ability and secret-keeping.

**Masking:**

Much like in poker, interests, thoughts, and emotions are sometimes better hidden in secrecy (Banerji, 1932). Keeping secrets and hiding these thoughts and emotions can be beneficial in a variety of ways ranging from avoiding conflict with others to winning a poker hand. Known in the psychological literature as masking, much research has explored individuals’ abilities to obscure the presence of one stimulus with the existence of another. As they attempt to hide their organic reactions to their hands,
poker players make efforts to mask themselves in various contexts such as arm movement, facial expression, and speech.

Research has demonstrated that masking facial expressions can be quite effective, however factors such as confidence and exposure time can influence one’s ability to see past the masking efforts (Esteves & Ohman, 1993). Facial cues can also be utilized as masking tools such the use of smiling to mask another emotion (Szarota, Bedynska, Matsumoto, Yoo, Friedlmeier, Sterkowics & Purwono, 2010). According to the literature, smiling is amongst the most efficient conscious efforts of masking negative emotions.

While playing the game, a poker player must be conscious of their actions and mental states. Their embodiment of strength may be telling of their hand strength and they therefore should be aware of how this cognitive state affects their sensorimotor movement and hide what they can. In poker, masking one’s organic reactions and keeping them a secret from other players is a vital component to winning. This may be difficult for a player who embodies strength or weakness and demonstrates physical displays throughout their plays. To truly hide all embodied cognition of strength, a player must be expert of deceiving their opponents away from their embodied motor actions.

Deception:

A large part of poker playing consists of fooling the opponent into believing one’s hand is different than is in actuality. Research suggests that there are various cues to detect deception (DePaulo, Lindsay, Malone, Muhlenbruck, Charlton, & Cooper,
Generally, the detection of deceit is stronger when a person is presented with more circumstantial information around the matter at hand (Millar & Millar, 1995). In searching for occurrences of trickery, one must take in as much information as possible to make the most accurate judgement. In poker, a player should be attentive of the cues expressed by other players in order to predict strength of a player’s hand. Some of these cues include: facial cues, speech, speed of decision-making, and confidence.

It is unknown how much individuals can improve their ability to detect deceit. Some research points that detecting deceit is a skill that can be learned and improved over time (Zuckerman, Koestner, & Colella, 1985; Biros, George, & Zmud, 2002). Part of the literature suggests that there are cues of deceit when it is present, and if enough attention is paid forward, it can be detected (Baron 1988). Bond and DePaulo, however, argue that there are no individual differences in detecting deceit (Bond 2008; Bond & DePaulo, 2008). Similarly, it has been shown that even individuals whose professions involve detecting deceit, can be poor judgers of lies (Ford & Price 1996; Vrij, 2004).

Some of the research exploring deception illustrates the nonverbal cues that can be identified (Ekman & Friesen, 1969). Research suggests that when determining deceitful behavior, more accurate judgements could be made while observing the body of a person compared to their face (Ekman & Friesen, 1974). It could be that a poker player is less deceptive through their body, such as their arms and hand, as a result of their embodied strength or weakness.

Aside from the physical motions a player makes throughout the game, their first glance at their hand may be poorly masked as they are oblivious to whether they have received a strong hand until the moment they glance at their cards. It may be too soon
for players to begin masking their thoughts and feelings and thus there may be a variable
that is revealing of their hand strength in early stages of the game such as glancing at
cards for the first time.

**Smoothness:**

Literature has shown an association between confidence and smoothness in
motor movement exists (Beuter & Duda, 1985; Beuter, Duda, & Widule, 1989). Confidence
should increase when a strong hand is recognized by a poker player. A positive
correlation should also exist between smoothness in motor movement and
strength of a poker player’s hand. Slepian, Young, Rutchick and Ambady specifically
looked at the hand movements in poker as players place their bets. They determined that
smoothness judgments were significant predictors of the likelihood of winning (Slepian,
Young, Rutchick & Ambady 2013). In their research, Slepian et al. selected thin-sliced
betting clips from the World Series of Poker (WSOP) and asked participants to rate each
player’s betting. These ratings of motor smoothness were significantly correlated with
the hand’s likelihood of winning (probability of a player winning the round). As a
player’s hand strength is directly related to their likelihood of winning, hand strength
should also correlate with the smoothness of a player’s bet-placing hand motions.
Current Study

It is generally to a poker player’s best interest to be consistent with every dealt hand in terms of their facial expressions, motions, and reactions as they play. While the development of the “poker face” can be mostly established, some variables remain relatively unaddressed. Because only minuscule differences can be observed in some variables, the current study aims to determine variables that are overlooked and are revealing of a player’s cards due to the embodiment of strength.

This study aimed to explain the variability of betting that predicts hand strength. After viewing their cards for the first time, a poker player must decide whether they would like to play the hand by placing a chip-bet forward or to forfeit the hand with a small revolving fee. During this process, a player may not realize the vulnerability of their play. Overreaching their bets closer to the middle may indicate strong hands, while hesitantly placing the bet to its minimum accepted distance may indicate weaker hands. With the embodiment of strength, players may extend further than they might otherwise. Similarly their chips may travel further distances as they bet. The embodiment of a player’s hand strength may disrupt a player’s awareness to be consistent among rounds, causing over performance of this simple task. Given the extensive support throughout the current literature, it is understandable that the ability to mask one’s emotions may not be as effective when a nonconscious form of strength has been embodiment of strength and is apparent during betting.

Another variable that was explored is the smoothness of hand motions as a player places a bet. This study also aimed to provide additional support to existing literature that there is a positive correlation between confidence, specifically
demonstrated through hand strength, and smoothness of motor movement (placing a bet). As stronger cards increase a poker player’s confidence, stronger cards should also correlate with smoothness of betting motions.

1. Poker players will extend their arms to greater distances when placing their chips bets when they hold stronger cards.
2. Larger chip distances while placing bets will predict stronger cards.
3. Ratings of card strength merely by watching a player place a bet will predict the poker player’s actual card strength.
4. Smoother hand movements when placing bets will predict stronger cards.
Methods:

Poker Clips

Permission was obtained to access videos of students playing poker at a poker school based out of Texas. The poker school allows players to learn poker strategy through playing and discussing the game, often through several sessions. Students typically include players with decent experience playing poker. A typical package from the academy includes a course with a guest instructor in addition to a seat to play poker, tournament style, which is recorded with feedback voiced-over. The tapes are then available to the player for their review.

Once acquired for the purposes of this study, these videos were assessed to explore the current study’s hypotheses. Ten clips were identified of amateur poker players from the videos provided by the poker school placing their bets. These clips included pre-flop (prior to community cards being dealt), first-to-bet actions. Clips included different players seated at different positions of the poker table and were two seconds each in length. The clips included the poker player reaching for the chips and completing their bet action.

Participants

A total of N=158 participants took a fifteen minute online survey programed through Qualtrics and recruited with mTurk. As a screening criteria, participants were asked to have some interest in poker. Each participant was compensated $0.40 for their participation. Seven participants were removed from the data file due to insufficient timing (less than one-fourth the median time taken to complete the survey (four minutes)) to yield a final sample size of N=151.

Procedure
Participants viewed each clip, in randomized order, and for each were asked to rate the distance of the players hand relative to the edge of the table as they place their bet (i.e. “On the following scale, please indicate how would you rate the distance of the player’s hand relative to the edge of the table as they reached their bet out? (0 to 100 where 0 is as small a distance as they could and 100 is as far a distance as they could)”). While a poker player’s hand reach may be representative of their overall hand strength, poker players may embody strength through betting in the form of tossing their chips; thus, in addition to the hand-distance ratings, participants were also be asked to rate the distance of the players chips relative to the edge of the table (i.e. “On the following scale, please indicate how would you rate the distance of the player’s chips as the bets were placed, NOT including the movement of their hand (0 to 100 where 0 is as small a distance as they could and 100 is as far a distance as they could)”). Participants were also be asked to rate the smoothness of the hand movements placing the bet (i.e. “On the following scale, please indicate how smooth the movement of the player’s hand was as they placed their bet (0 to 100 where 0 is as unsmooth of a movement they could have made and 100 is as smooth of a movement they could have made)”), and the predicted strength of the player’s cards either before or after the other three ratings (“On the following scale, please indicate how strong you think the player’s cards are (0 to 100 where 0 is the weakest of cards and 100 is the strongest of cards)").

Prior to viewing the poker clips, participants were asked to rate how experienced they are in the game of poker (“On the following scale, please indicate how experienced you feel you are in the game of poker (0 to 100 where 0 is the least experienced player and 100 is the most experienced player)”). This measure of self-reported experience was
be used as a covariate in the analyses. To control for the position of the player’s action (first to act, second to act, etc.), the number of players who have folded before the action will be measured and used in analysis as a covariate. In poker, the first person to make a bet is not always the first person to act; this may influence others’ willingness to play their hand, and thus this variability was controlled for in the analyses.

The strength of each hand was be calculated using the Chen Formula, a well-known measure used throughout the poker community. The formula ranks poker hands from a continuous scale of -1 to 20 and considers various strength characteristics such as high cards, suitedness, and connectivity.

Regression analyses were be conducted to determine if (1) rated smoothness of hand motion when placing bets predicts hand strength, (2) rated hand strength predicts actual hand strength, (3) rated distances of chip and arm while betting predicts hand strength, and (4) if all four independent variables (rated smoothness, rated strength, rated distance of chips, rated distance of arm) together predicts hand strength better than any of the four predictors independently. The self-reported experience of the player and the number of people who have folded will be used as controlled covariates within all regressions.

Results

The ten video clips included a variety of hand strengths, rating from values from 5 to 18 points on the Chen scale ($M = 11.4$, $SD = 5.62$). The position of the bet also varied from 0 (first to play) to 4 players preceding the pre-flop bet ($M = 1.4$, $SD = 1.34$). All five variables were assessed, both individually and as a composite model.
Various regression analyses were conducted to explore the five independent variables’ (rated hand strength, rated smoothness, rated hand distances, and rated chip distances) predictive significance of actual card strength. In all analyses self-reported experience and number of players before were controlled for in a preliminary model as covariates. Self-reported experience and the prior number of plays explained a significant amount of hand strength $F(2, 1509) = 111.37, p < 0.01$. While controlling for these covariates, further analyses revealed significant findings.

A linear regression was run to determine if Smoothness significantly predicted card strength, controlling for self-reported experience and number of plays before the bet. Contrary to previous findings and hypothesized results, Smoothness significantly predicted card strength negatively $b = -0.06, t(1509) = -2.42, p = 0.02$.

Holding the two covariates constant, a linear regression was run to determine if rated hand strength predicted actual card strength. The analysis revealed that predicted hand strength significantly and negatively predicted card strength $b = -0.11, t(1509) = -4.39, p < 0.01$.

Another linear regression was run to determine if rated hand distances while betting predicted card strength while controlling for self-reported experience and number of plays before the bet. The analysis yielded that rated hand distances do not significantly predict card strength $b = 0.04, t(1509) = 1.50, p = 0.13$. As chip distances were rated independent of hand distances in betting, an independent linear regression was run including chip distances. Rated chip distances did not significantly predict card strength $b = -0.01, t(1509) = -0.20, p = 0.84$. 
The hypothesized multi-model regression was run, controlling for self-reported experience as well as the number of plays before the bet, and including rated smoothness, hand strength, hand distance, and chip distance. The overall model significantly predicted card strength $F(6, 1509) = 42.29, p < 0.01$. Individually, smoothness did not significantly contribute to the model, $b = -0.02, t(1509) = -0.89, p = 0.38$, rated hand strength did significantly contribute to the predictive model negatively, $b = -0.11, t(1509) = -4.15, p < 0.01$, rated chip distances did not significantly contribute to the model $b = -0.01, t(1509) = -0.49, p = 0.65$, and rated hand distances significantly contributed to the model positively $b = 0.07, t(1509) = 2.64, p < 0.01$. 
Discussion

The results of this study show that (1) rated card strength significantly and negatively predicts card strength, (2) smoothness of hand movements does not predict card strength, especially in the direction the literature suggests, (3) rated chip distances do not significantly predict card strength and (4) rated hand distances significantly predict card strength. The hypothesis that greater hand distances while placing bets would predict stronger cards was supported. The other three hypotheses did not find support from the findings of the current study. Various explanations for these results and recommendations for future studies are described.

While being assessed together, both covariates demonstrated a significant explanation of the variance in card strength. In assessing the two covariates (number of players who folded prior to the bet and poker experience of the rater) independently there are big differences in their individual contributions. The number of players who folded prior to the bet negatively and significantly predicted card strength. This was expected; the more players who have folded the more comfortable a player is to enter the game, as their odds of winning increase, and having fewer players fold their hand would require stronger cards as there is potential for increased competition. However, self-reported levels of experience did not significantly contribute to the covariance model. Perhaps this is due to the lack of efficient anchoring of the question. As the question asked participants to rank their experience with poker from the least experienced poker player to the most experienced player participants may have had different ideas on what the description of each of those compared to what was intended. Future studies should consider setting more prominent anchors when asking raters to rank experience, perhaps
by introducing a score of 0 as a representation of someone who has played less than 5 hours of poker and a score of 100 as a professional poker player who has played thousands of hours of poker. The literature does demonstrate issues with overrating knowledge of poker among poker players (Calvillo & Rutchick, 2014). An alternative approach would be to measure each player’s level of experience using an assessed poker knowledge questionnaire.

Although past research has suggested that smoothness of a player’s hand motion may be revealing of their poker hands (Slepian, Young, Rutchick, & Ambady, 2013), the current study’s findings did not concur. Smoothness may not be an embodiment of strength as it relates to card play. In collecting data surrounding smoothness of hand movement, further research should emphasize the view of the participant to the area of interest. While participants were asked to rate the smoothness of the players’ hands while betting, the focus of the participant may have been shifted to the player, chips, or other extraneous items visible in the camera shot. Further measures of smoothness should isolate the motor movement being measured (the players’ hands in this study) in order to capture a more accurate rating of motor smoothness. Additionally, smoothness was left open for interpretation by participants. These subjective measure may have caused the data to sway in a different operationalization of smoothness than was intended. This may be the difference in results between this study and past findings from previous literature. Slepian et al (2013) asked participants “How smooth is this person’s movements” on a one to seven likert-scale (not at all to very). The current study intended for the same operationalization of smoothness, however due to the difference in wording of the current study (“On the following scale please indicate how smooth the
movement of the player’s hand was as they placed their bet, 0 to 100 where 0 is as unsmooth of a movement they could have made and 100 is as smooth of a movement they could have made”) participants may have been rating the videos on a different operationalization as the former measure. Future studies should provide participants with clear definitions of smooth movements prior to presenting them with any ratings involving smoothness, perhaps by showing an example of an extremely unsmooth movement and an example of an extremely smooth movement.

In previous research it is suggested that poker players do not guess a player’s hand significantly by looking at clips of betting (Slepian, Young, Rutchick, & Ambady, 2013). The current study’s hypothesis that participants in this study would significantly and positively predict actual card strength from their ratings was due to the nature of the poker players in the clips. Slepian and colleagues included video clips from the World Series of Poker, which mostly includes very well experienced poker players. The current study included videos of players who do not have as much experience with poker, and presumably are not as effective at masking their hands. The results did not show that these less experienced players were less efficient at masking their card strength. The current study found that participants rated the players cards significantly worse than chance. This is perhaps due to the trained player’s ability to trick the opponent into thinking they have a different card than they actually do, or at least not hold the card they do. As Slepian et al. (2013) discern in their research, this may be due to the chest-up view of the player. Further research may investigate differences of this masking effect through the view of the hands and face separately to identify if there are differences in accuracy of ratings of cards between the two.
The physical distances of the players’ reach as they placed their bets may have been a measure of embodiment. Theoretically, strong cards should influence embodiment of strength, influencing greater reach distances as players placed bets. While this study’s findings are limited in the generalizability to embodiment, the results showed that rated hand distances positively predicted card strength significantly. While the effect of distance was seen in the full model and not seen as prominently alone, it is possible that the variance hand distance and card strength share is unique from the other variables, and thus the variance of hand distance that explains card strength was not shared within the full model. The hypothesis that longer reaches would predict stronger cards was supported. As this is supportive of the theory of strength embodiment, the application of such findings can be useful in a variety of ways. As previous literature has mentioned, embodying strength and confidence can help performance of an interview (Cuddy, Wilmuth, Yap & Carney, 2015). Confidence and strength have also seen to help individuals perform well during both physical and non-physical competitions (Kamas & Preston, 2012), as well the ability to be a good salesperson (Handrivanto, Christiano, & Smarandache, 2010).

Chip distances did not significantly predict card strength. This is perhaps due to the difference between the players’ intended chip distances and where the chips ultimately land. For example, chips of a betting player throwing with less strength may travel shorter distances than those players who place their chips looser, but travel further. The embodiment of strength is therefore not captured accurately, as supported in the current study. Perhaps a better approach to the distance the chips travel would be to measure how far the chips were from the edge of the table as they first hit the felt.
This study introduced the notion that strength may be embodied through stronger hand movement in the context of poker. It is interesting that, despite masking efforts, poker players do not seem to control the distance they reach out while placing their bets. The finding that hand distance positively predicts actual card strength suggests that despite the eagerness of poker players to hide their thoughts and emotion, the feelings that are created as a result of their cards may be embodied and demonstrated in their play. While the process of embodying a thought is nonconscious (Yogo, Hama, Yogo, & Matsuyama, 1995), it may be difficult to mask all of the physiological forms embodiment may influence.

Future research should use additional clips to evaluate the constancy of these findings as well as explore different areas where embodiment may possibly be captured. Still to be determined is the accuracy of the ratings of distance from participants. Future research may take a more objective, quantitative measurement approach to determine if rated distances of arm reach are, in fact, accurately measured through rating scales. Additionally, in order to prevent any spillover effect from the four measures (hand distance, chip distance, smoothness, and rated hand strength), future research may separate each of these as independent studies, allowing each variable to be measured in isolation of the others.
Appendix

*The Chen Formula* is a well-known and widely accepted poker-hand measure used to determine relative two-card strength (Teófilo & Reis, 2011); it was developed in 2006 by William Chen, a mathematician and professional poker player with winnings exceeding $1,000,000. The continuous scale ranks poker hands from -1 to +20. The formula for determining the score of a hand using the Chen formula is as follows:

1. Score the highest card, such that A = 10 points, K = 8 points, Q = 7 points, J = 6 points, and cards from 10 to 2 are worth half the card value. (e.g. Q9 is scored 7)
2. Double the value if the two cards are a pair and 5 or greater (e.g. QQ is scored 14)
3. Add two points if the two cards are suited
4. Subtract points respectively if there is a gap between the two cards:
   a. No gap = do not subtract any points
   b. 1 card gap = subtract 1 point
   c. 2 card gap = subtract 2 points
   d. 3 card gap = subtract 4 points
   e. 4 or more card gap = subtract 5 points
   f. In this step, As do not connect with low cards (e.g. A2 has a 4+ card gap)
5. Add 1 point if both cards are less than Q and there is a 1 card or no card gap (e.g. J10 would get a bonus point; bonus points are not awarded to pairs)
6. Half point scores round up (e.g. 4.5 rounds to 5)
Operationalization of variables:

**Experience:** On the following scale, please indicate how experienced you feel you are in the game of poker (0 to 100 where 0 is the least experienced player and 100 is the most experienced player)

**Hand distance:** On the following scale, please indicate how would you rate the distance of the player’s hand relative to the edge of the table as they reached their bet out? (0 to 100 where 0 is as small a distance as they could and 100 is as far a distance as they could)

**Chip distance:** On the following scale, please indicate how would you rate the distance of the player’s chips as the bets were placed, NOT including the movement of their hand (0 to 100 where 0 is as small a distance as they could and 100 is as far a distance as they could)

**Smoothness:** On the following scale, please indicate how smooth the movement of the player’s hand was as they placed their bet (0 to 100 where 0 is as unsmooth of a movement they could have made and 100 is as smooth of a movement they could have made)

**Hand strength:** On the following scale, please indicate how strong you think the player’s cards are (0 to 100 where 0 is the weakest of cards and 100 is the strongest of cards)
References


Handriyanto, D., Christianto, V., & Smarandache, F. (2010). Have you ever met a salesman who is so confident and has excellent sales performance with apparent ease?. Multispace & Multistructure. Neutrosophic Transdisciplinarity (100 Collected Papers of Science), 4, 119.


