

Quality of Professional Players' Poker Hands Is Perceived Accurately From Arm Motions

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In the card game of poker, players attempt to disguise cues to the quality of their hand, either by concealment (e.g., adopting the well-known, expressionless “poker face”) or by deception. Recent work, however, demonstrates that motor actions can sometimes betray intentions. The same action can have different movement dynamics depending on the underlying intention (Becchio, Sartori, & Castiello, 2010), and these subtle differences can be decoded by observers (Becchio, Manera, Sartori, Cavallo, & Castiello, 2012; Sartori, Becchio, & Castiello, 2011). Thus, professional poker players' intentions may be visible from their actions while moving poker chips to place bets. Even though professional players may be able to regulate their facial expressions, their motor actions could betray the quality of their poker hand. In three studies, we tested this hypothesis by examining observers' perceptions of poker-hand quality. We also examined individual differences in sensitivity to nonverbal behavior and potential diagnostic motor behaviors as cues to hand quality.

Study 1

Twenty brief silent video clips (mean duration = 1.60 s, $SD = 0.68$ s) of professional poker players placing a bet were extracted from randomly sampled videos of the 2009 World Series of Poker (WSOP) tournament. Three versions of each clip were produced: Unaltered clips showed players' bodies from the table up, face-only clips showed players from the chest up, and arms-only clips showed only players' arms pushing chips into the table. Each player's objective likelihood of winning during the bet was known (WSOP displays these statistics on-screen; however, we kept this information from participants by obscuring part of the screen). The number of chips wagered was not confounded with the likelihood of winning (i.e., chip values varied markedly—no participants were poker experts nor knew chip values; see the

Supplemental Material available online for information about the game of poker, WSOP, and further methodological details).

Seventy-eight undergraduates were divided into three groups based on the type of clip they were shown. Each group viewed the 20 clips in a random order and judged the quality of each poker hand (1 = *very bad*, 7 = *very good*). Next, participants rated their overall confidence in their judgments (1 = *not at all confident*, 7 = *very confident*) and their experience with poker (1 = *none*, 7 = *a lot*). Finally, they completed a measure of nonverbal sensitivity (Bänziger, Scherer, Hall, & Rosenthal, 2011).

Data were analyzed using multilevel linear models with quality ratings of the hand depicted in each clip, nested within participants, predicting objective likelihoods of winning. Specifically, the model included participants' quality ratings at Level 1, a set of dummy codes representing condition at Level 2 (the face-only condition was the reference group because our primary hypothesis concerned a comparison between judgments based on facial expressions vs. arm movements or vs. upper-body movements), and all interactions predicting objective likelihoods of winning. This analysis revealed the predicted interaction between the arms-only (vs. face-only) condition and quality ratings, $b = 1.68$, $t(1554) = 2.88$, $p = .004$, such that the arms-only group's ratings significantly predicted likelihoods of winning, $b = 0.94$, $t(1554) = 2.26$, $p = .02$, whereas the face-only group's ratings marginally inversely predicted likelihoods of winning, $b = -0.74$, $t(1554) = -1.81$, $p = .07$. The interaction between the

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upper-body (vs. face-only) condition and quality ratings was not significant, $b = 0.95$, $t(1554) = 1.65$, $p = .10$. Reconducting these analyses with the individual-difference measures entered as predictors revealed no two- or three-way interactions, $ps > .07$.¹

We also examined participants' accuracy scores, which were computed by correlating participants' poker-hand ratings with players' objective likelihoods of winning. If these scores were significantly different from zero, performance was different from chance (Table 1). Correlations between these accuracy scores and participants' nonverbal sensitivity, poker experience, and overall confidence in their judgments were separately explored (Table 1). These analyses also showed that judgments in the face-only group were marginally worse than chance, which suggests that players exhibited deceptive facial cues. When isolating arm movements, however, analyses showed that untrained participants judged the quality of poker hands better than chance, which suggests that perceptions of arm movements exert an independent influence on judgments of poker-hand quality. Judgments made when viewing the players' upper body (arm motions plus the face) were at chance. Additionally, when watching arm motions only, participants' nonverbal sensitivity and poker experience were positively correlated with their accuracy.

Study 2

In Study 2, we replicated the arms-only accuracy finding from Study 1 with a new set of silent video clips to ensure the generalizability of the effect. Twenty-two new, randomly sampled, chest-down close-ups of players placing bets during the 2009 WSOP were extracted from video clips as in Study 1 (mean duration = 1.54 s, $SD = 0.74$ s). Again, the number of chips wagered was not confounded

with the likelihood of winning (see the Supplemental Material). Thirty undergraduates judged poker-hand quality from these new clips. As in the previous study, data were analyzed with a multilevel model. Results replicated those of Study 1. When participants viewed arm motions, their judgments again predicted the objective quality of professional poker players' hands, $b = 1.46$, $t(558) = 2.70$, $p = .004$. Participants' performance was greater than chance when they judged poker-hand quality from viewing players' arm motions (Table 1).

Study 3

Players who have strong poker hands should be more confident than players who have weak hands, and perhaps this confidence is expressed in motor actions. To the extent that participants' poker-hand quality ratings were influenced by player confidence, having participants judge player confidence could yield similar results. Previous work demonstrates that anxiety disrupts smoothness of body movement (Beuter & Duda, 1985), which suggests that confidence (i.e., lack of anxiety) might be revealed via smoother actions. Therefore, in Study 3, we had participants in one condition judge player confidence, and in a second condition, they judged how smoothly the chips were pushed into the center of the table. If greater confidence in players relates to smoother motor action, smoothness judgments might also predict likelihoods of winning.

Forty undergraduates viewed the same randomly ordered videos from Study 2, judging player confidence ("How confident does this person seem?") or action smoothness ("How smooth is this person's movement?"; 1 = *not at all*, 7 = *very*). They subsequently completed the measure of nonverbal sensitivity used in Study 1. We ran a multilevel model, including participants' quality

Table 1. Mean Accuracy in All Conditions and Correlations Between Accuracy and Individual-Difference Measures

Study and condition	Mean accuracy	Correlations		
		Nonverbal sensitivity	Poker experience	Confidence in judgments
Study 1				
Upper body	.02 [−.06, .09]	.14	.14	.19
Face only	−.07 [−.15, .01]	.17	−.32	−.26
Arms only	.07 [.01, .14]	.40*	.39*	.26
Study 2	.15 [.11, .19]	—	—	—
Study 3				
Player confidence	.15 [.07, .24]	.46*	—	—
Smoothness of movement	.29 [.22, .36]	.14	—	—

Note: Accuracy scores are the correlation of participants' ratings of the quality of poker hands with players' objective likelihoods of winning. Values in brackets are 95% confidence intervals (created using Fisher's transformed z s and then converted back to r values). If the 95% confidence interval includes zero, accuracy is at chance.

* $p < .05$.

ratings at Level 1, a dummy code representing judgment condition (with the player-confidence condition as the reference group) at Level 2, and the interaction predicting objective likelihoods of winning. Analyses revealed a main effect of participants' quality ratings, $b = 3.33$, $t(855) = 4.17$, $p < .001$, but no significant interaction of ratings with judgment condition, $b = 0.54$, $t(855) = 0.58$, $p = .56$. Reconducting this analysis with the addition of participants' nonverbal-sensitivity scores and all interactions did not reveal any significant main effects of nonverbal sensitivity or interactions with nonverbal sensitivity and other variables, $ps < .64$. Thus, both player confidence and smoothness judgments significantly predicted likelihoods of winning, which suggests that movement smoothness might be a valid cue for assessing poker-hand quality. It is unknown, however, how participants interpreted "smoothness" or whether the players' movements that participants rated as smooth were truly smoother than other players' movements. Other physical factors, such as speed, likely played a role (see Patel, Fleming, & Kilner, 2012).

As in Study 1, we also explored correlations between participants' nonverbal sensitivity and accuracy scores. Participants' nonverbal sensitivity significantly correlated with their accuracy as indexed by ratings of players' confidence, but not with their accuracy as indexed by ratings of players' smoothness of movement (Table 1), which suggests the possibility that individual differences in nonverbal sensitivity can be overcome when participants are explicitly directed to attend to potentially diagnostic motor cues.²

Discussion

In three studies with two unique video sets, observers naive to the quality of professional players' poker hands could judge, better than chance, poker-hand quality from merely observing players' arm actions while placing bets. The accuracy of participants' judgments when viewing players' upper bodies was no different from chance, and when observing players' faces, participants' accuracy was nearly worse than chance, which suggests that players' facial cues were deceptive. Arm motions might provide a more diagnostic cue to poker-hand quality than other nonverbal behaviors. Additionally, correlations between nonverbal sensitivity and accuracy from viewing arm motions suggest a positive relationship between the two (see Table 1), and movement smoothness might be a valid cue for assessing poker-hand quality, although more research is needed to document the moderators of the present effects.

These findings are notable because the players in the stimulus clips were highly expert professionals competing in the high-stakes WSOP tournament. Additionally, judges were untrained observers (cf. Ekman & O'Sullivan,

1991) watching clips on average less than 2 s long (see Ambady & Rosenthal, 1992). Nevertheless, professional poker players' motor actions were revealing, enabling perceivers to decode poker-hand quality from minimal visual information. Even in very restrictive settings, motor actions can yield important diagnostic information.

Author Contributions

M. L. Slepian, S. G. Young, A. M. Rutchick, and N. Ambady conceived and designed the studies. M. L. Slepian, S. G. Young, and A. M. Rutchick conducted the studies and analyzed the data. All authors wrote the manuscript.

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Declaration of Conflicting Interests

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Supplemental Material

Additional supporting information may be found at <http://pss.sagepub.com/content/by/supplemental-data>

Notes

1. The Quality Rating \times Upper-Body Condition (vs. Face-Only Condition) \times Participant Confidence interaction was significant, $b = -0.71$, $t(1476) = -2.19$, $p = .03$, but subsequent two-way interactions were nonsignificant, $ps > .07$, which makes it difficult to interpret the three-way interaction.
2. Additionally, smoothness judgments yielded larger accuracy than confidence judgments. This is an example of when judgments in a "micro" domain (physical properties of action) may be a more diagnostic cue than judgments in a "molar" domain (the meaning behind an action), whereas the reverse is typically the case (see Weisbuch, Slepian, Clarke, Ambady, & Veenstra-Van der Weele, 2010). Such conclusions about greater accuracy, or higher correlations, in one condition than in the other must be made with caution, however, because neither nonverbal sensitivity nor judgment condition significantly interacted with quality ratings in predicting objective likelihoods to win.

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