# Inferences of Competence from Faces Predict Election Outcomes

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We suspect that this system is not unique. Several cod stocks, inhabiting similar oceanographic regimes (north of 44°N latitude) in the northwest Atlantic where they were the dominant predators, collapsed in the early 1990s (decline by >95% of maximum historical biomass) and failed to respond to complete cessation of fishing [there was one exceptional stock (table S1)]. For example, the current biomass of these stocks has increased only slightly, ranging from 0.4 to 7.0% during the past 10+ years (table S1). Reciprocal relationships between macroinvertebrate biomass and cod abundance in these areas (*12*) suggest that the processes that we document for the Scotian Shelf may have occurred there. On the other hand, the three major cod stocks resident south of 44° N, though reaching historical minimum levels at about the same time as the northerly stocks and experiencing similar intensive fishing pressure, declined by only 50 to 70%; current biomass has increased from 10 to 44% of historical minimum levels. These stocks inhabit different oceanographic regimes with respect to temperature and stratification and do not show the inverse relationship between the biomass of macroinvertebrates and cod found by Worm and Myers (*12*). These geographic differences in cod population dynamics merit additional study.

The changes in top-predator abundance and the cascading effects on lower trophic levels that we report reflect a major perturbation of the eastern Scotian Shelf ecosystem. This perturbation has produced a new fishery regime in which the inflation-adjusted, monetary value of the combined shrimp and crab landings alone now far exceed that of the groundfish fishery it replaced (*13*). From an economic perspective, this may be a more attractive situation. However, one cannot ignore the fundamental importance of biological and functional diversity as a stabilizing force in ecosystems, and indeed in individual populations (*20*), in the face of possible future perturbations (whether natural or human-made). One must acknowledge the ecological risks inherent in "fishing down the food web" (*21*), as is currently occurring on the Scotian Shelf, or the ramifications associated with indirect effects reverberating across levels throughout the food web, such as altered primary production and nutrient cycling.

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# Inferences of Competence from Faces Predict Election Outcomes

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**We show that inferences of competence based solely on facial appearance predicted the outcomes of U.S. congressional elections better than chance (e.g., 68.8% of the Senate races in 2004) and also were linearly related to the margin of victory. These inferences were specific to competence and occurred within a 1-second exposure to the faces of the candidates. The findings suggest that rapid, unreflective trait inferences can contribute to voting choices, which are widely assumed to be based primarily on rational and deliberative considerations.**

Faces are a major source of information about other people. The rapid recognition of familiar individuals and communication cues (such as expressions of emotion) is critical for successful social interaction (*1*). However, people go beyond the inferences afforded by a person's facial appearance to make inferences about personal dispositions (*2*, *3*). Here, we argue that rapid, unreflective trait inferences from faces influence consequential decisions. Specifically, we show that inferences of competence, based solely on the facial appearance of political candidates and with no prior knowledge about the person, predict the outcomes of elections for the U.S. Congress.

In each election cycle, millions of dollars are spent on campaigns to disseminate information about candidates for the U.S. House of Representatives and Senate and to convince citizens to vote for these candidates. Is it possible that quick, unreflective judgments based solely on facial appearance can predict the outcomes of these elections? There are many reasons why inferences from facial appearance should not play an important role in voting decisions. From a rational perspective, information about the candidates should override any fleeting initial impressions. From an ideological perspective, party affiliation should sway such impressions. Party affiliation is one of the most important predictors of voting decisions in congressional elections (*4*). From a voter's subjective perspective, voting decisions are justified not in terms of the candidate's looks but in terms of the candidate's position on issues important to the voter.

Yet, from a psychological perspective, rapid automatic inferences from the facial appearance of political candidates can influence processing of subsequent information about these candidates. Recent models of social cognition and decision-making (*5*, *6*) posit a qualitative distinction between fast, unreflective, effortless "system 1" processes and slow, deliberate, effortful "system 2" processes. Many inferences about other people, including inferences from facial appearance,

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can be characterized as system 1 processes (*7*, *8*). The implications of the dual-process perspective are that person impressions can be formed "on-line" in the very first encounter with the person and can have subtle and often subjectively unrecognized effects on subsequent deliberate judgments.

Competence emerges as one of the most important trait attributes on which people evaluate politicians (*9*–*11*). If voters evaluate political candidates on competence, inferences of competence from facial appearance could influence their voting decisions. To test this hypothesis, we asked naïve participants to evaluate candidates for the U.S. Senate (2000, 2002, and 2004) and House (2002 and 2004) on competence (*12*). In all studies, participants were presented with pairs of black-and-white head-shot photographs of the winners and the runners-up (Fig. 1A) from the election races. If participants recognized any of the faces in a race pair, the data for this pair were not used in subsequent analyses. Thus, all findings are based on judgments derived from facial appearance in the absence of prior knowledge about the person.

As shown in Table 1, the candidate who was perceived as more competent won in 71.6% of the Senate races and in 66.8% of the House races (*13*). Although the data for the 2004 elections were collected before the actual elections (*14*), there were no differences between the accuracy of the prospective predictions for these elections and the accuracy of the retrospective predictions for the 2000 and 2002 elections (*15*). Inferences of competence not only predicted the winner but also were linearly related to the margin of victory. To model the relation between inferred competence and actual votes, we computed for each race the difference in the proportion of votes (*16*). As shown in Fig. 1B, competence judgments were positively correlated with the differences in votes between the candidates for Senate [$r(95) = 0.44$, $P < 0.001$] (*17*, *18*). Similarly, the correlation was 0.37 ($P < 0.001$) for the 2002 House races and 0.44 ($P < 0.001$) for the 2004 races. Across 2002 and 2004, the correlation was 0.40 ($P < 0.001$).

In the previous studies, there were no time constraints on the participants' judgments. However, system 1 processes are fast and efficient. Thus, minimal time exposure to the faces should be sufficient for participants to make inferences of competence. We conducted an experiment in which 40 participants (*19*) were exposed to the faces of the candidates for 1 s (per pair of faces) and were then asked to make a competence judgment. The average response time for the judgment was about 1 s (mean = 1051.60 ms, SD = 135.59). These rapid judgments based on minimal time exposure to faces predicted 67.6% of the actual Senate races ($P <$ 0.004) (*20*). The correlation between competence judgments and differences in votes was 0.46 ($P < 0.001$).

The findings show that 1-s judgments of competence suffice to predict the outcomes of actual elections, but perhaps people are making global inferences of likability rather than specific inferences of competence. To address this alternative hypothesis, we asked participants to make judgments on seven different trait dimensions: competence, intelligence, leadership, honesty, trustworthiness, charisma, and likability (*21*). From a simple halo-effect perspective (*22*), participants should evaluate the candidates in the same manner across traits. However, the trait judgments were highly differentiated. Factor analysis showed that the judgments clustered in three distinctive factors: competence (competence, intelligence, leadership), trust (honesty, trustworthiness), and likability (charisma, likability), each accounting for more than 30% of the variance in the data (table S1). More important, only the judgments forming the competence factor predicted the outcomes of the elections. The correlation between the mean score across the three judgments (competence, intelligence, leadership) and differences in votes was 0.58 ($P < 0.001$). In contrast to competence-related inferences, neither the trust-related inferences ($r = -0.09$, $P = 0.65$) nor the likability-related inferences ($r = -0.17$, $P = 0.38$) predicted differences in votes. The correlation between the competence judgment

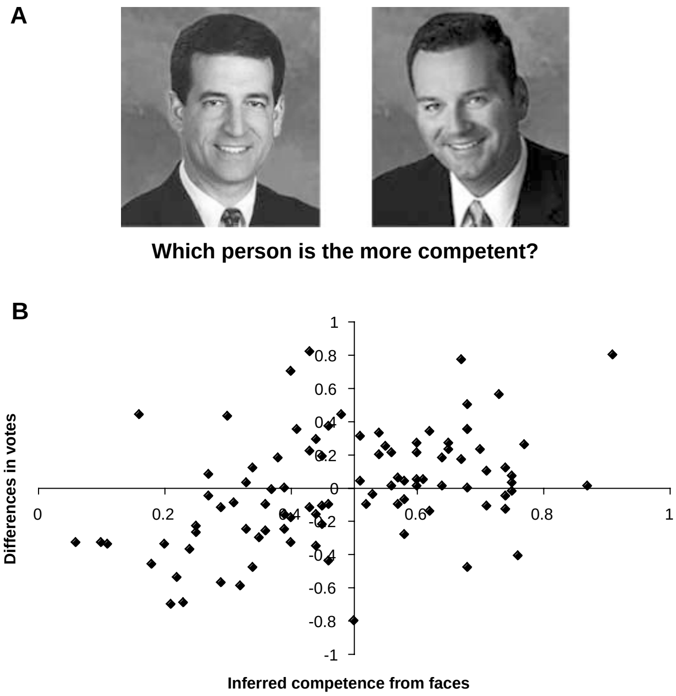


**Fig. 1.** (**A**) An example of a pair of faces used in the experiments: the 2004 U.S. Senate race in Wisconsin. In all experiments, the positions of the faces were counterbalanced. (**B**) Scatterplot of differences in proportions of votes between the winner and the runner-up in races for the Senate as a function of inferred competence from facial appearance. The upper right and lower left quadrants indicate the correctly predicted races. Each point represents a Senate race from 2000, 2002, or 2004. The competence score on the *x* axis ranges from 0 to 1 and represents the proportion of participants judging the candidate on the right to be more competent than the one on the left. The midpoint score of 0.50 indicates that the candidates were judged as equally competent. The difference in votes on the *y* axis ranges from −1 to +1 [(votes of candidate on the right – votes of candidate on the left)/(sum of votes)]. Scores below 0 indicate that the candidate on the left won the election; scores above 0 indicate that the candidate on the right won the election. [Photos in (A): Capitol Advantage]

**Table 1.** Percentage of correctly predicted races for the U.S. Senate and House of Representatives as a function of the perceived competence of the candidates. The percentages indicate the races in which the candidate who was perceived as more competent won the race. The $\chi^2$ statistic tests the proportion of correctly predicted races against the chance level of 50%.

| Election | Correctly predicted | $\chi^2$ |
|---|---|---|
| | *U.S. Senate* | |
| 2000 ($n$ = 30) | 73.3% | 6.53 ($P < 0.011$) |
| 2002 ($n$ = 33) | 72.7% | 6.82 ($P < 0.009$) |
| 2004 ($n$ = 32) | 68.8% | 4.50 ($P < 0.034$) |
| Total ($n$ = 95) | 71.6% | 17.70 ($P < 0.001$) |
| | *U.S. House of Representatives* | |
| 2002 ($n$ = 321) | 66.0% | 33.05 ($P < 0.001$) |
| 2004 ($n$ = 279) | 67.7% | 35.13 ($P < 0.001$) |
| Total ($n$ = 600) | 66.8% | 68.01 ($P < 0.001$) |

alone and differences in votes was 0.55 ($P < 0.002$), and this judgment correctly predicted 70% of the Senate races ($P < 0.028$). These findings show that people make highly differentiated trait inferences from facial appearance and that these inferences have selective effects on decisions.

We also ruled out the possibility that the age, attractiveness, and/or familiarity with the faces of the candidates could account for the relation between inferences of competence and election outcomes. For example, older candidates can be judged as more competent (*23*) and be more likely to win. Similarly, more attractive candidates can be judged more favorably and be more likely to win (*24*). In the case of face familiarity, though unrecognized by our participants, incumbents might be more familiar than challengers, and participants might have misattributed this familiarity to competence (*25*). However, a regression analysis controlling for all judgments showed that the only significant predictor of differences in votes was competence (Table 2). Competence alone accounted for 30.2% of the variance for the analyses of all Senate races and 45.0% of the variance for the races in which candidates were of the same sex and ethnicity. Thus, all other judgments combined contributed only 4.7% of the variance in the former analysis and less than 1.0% in the latter analysis.

Actual voting decisions are certainly based on multiple sources of information other than inferences from facial appearance. Voters can use this additional information to modify initial impressions of political candidates. However, from a dual-system perspective, correction of intuitive system 1 judgments is a prerogative of system 2 processes that are attention-dependent and are often anchored on intuitive system 1 judgments. Thus, correction of initial impressions may be insufficient (*26*). In the case of voting decisions, these decisions can be anchored on initial inferences of competence from facial appearance. From this perspective, in the absence of any other information, voting preferences should be closely related to such inferences. In real-life voting decisions, additional information may weaken the relation between inferences from faces and decisions but may not change the nature of the relation.

To test this hypothesis, we conducted simulated voting studies in which participants were asked to choose the person they would have voted for in a political election (*27*). If voting preferences based on facial appearance derive from inferences of competence, the revealed preferences should be highly correlated with competence judgments. As shown in Fig. 2, the correlation was 0.83 ($P < 0.001$) (*28*). By comparison, the correlation between competence judgments and actual differences in votes was 0.56 ($P < 0.001$). These findings suggest that the additional information that voters had about the candidates diluted the effect of initial impressions on voting decisions. The simulated votes were also correlated with the actual votes [$r(63) = 0.46$, $P < 0.001$] (*29*, *30*). However, when controlling for inferences of competence, this correlation dropped to 0.01 ($P = 0.95$), which suggests that both simulated and actual voting preferences were anchored on inferences of competence from facial appearance.

Our findings have challenging implications for the rationality of voting preferences, adding to other findings that consequential decisions can be more "shallow" than we would like to believe (*31*, *32*). Of course, if trait inferences from facial appearance are correlated with the underlying traits, the effects of facial appearance on voting decisions can be normatively justified. This is certainly an empirical question that needs to be addressed. Although research has shown that inferences from thin slices of nonverbal behaviors can be surprisingly accurate (*33*), there is no good evidence that trait inferences from facial appearance are accurate (*34*–*39*). As Darwin recollected in his autobiography (*40*), he was almost denied the chance to take the historic Beagle voyage—the one that enabled the main observations of his theory of evolution—on account of his nose. Apparently, the captain did not believe that a person with such a nose would "possess sufficient energy and determination."

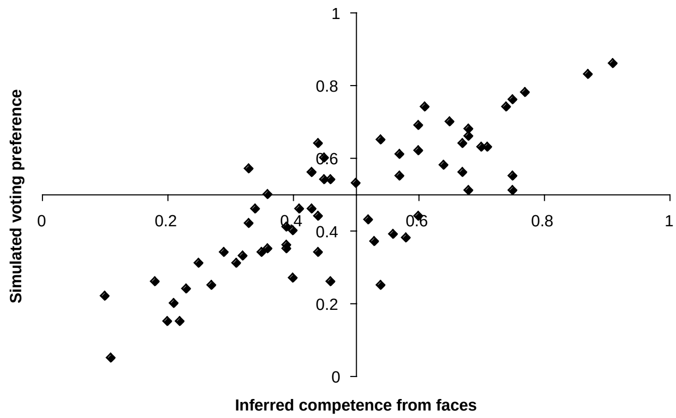


**Fig. 2.** Scatterplot of simulated voting preferences as a function of inferred competence from facial appearance. Each point represents a U.S. Senate race from 2000 or 2002. One group of participants was asked to cast hypothetical votes and another group was asked to judge the competence of candidates. Both the competence score and the voting preference score range from 0 to 1. The competence score represents the proportion of participants judging the candidate on the right to be more competent than the one on the left. The preference score represents the proportion of participants choosing the candidate on the right over the one on the left. The midpoint score of 0.50 on the *x* axis indicates that the candidates were judged as equally competent. The midpoint score of 0.50 on the *y* axis indicates lack of preference for either of the candidates.

**Table 2.** Standardized regression coefficients of competence, age, attractiveness, and face familiarity judgments as predictors of differences in proportions of votes between the winner and the runner-up in races for the U.S. Senate in 2000 and 2002. Matched races are those in which both candidates were of the same sex and ethnicity.

| Predictor | Differences in votes between winner and runner-up | |
|---|---|---|
| | All races | Matched races |
| Competence judgments | 0.49 ($P < 0.002$) | 0.58 ($P < 0.002$) |
| Age judgments | 0.26 ($P < 0.061$) | 0.07 ($P = 0.62$) |
| Attractiveness judgments | 0.07 ($P = 0.63$) | 0.08 ($P = 0.62$) |
| Face familiarity judgments | –0.05 ($P = 0.76$) | 0.03 ($P = 0.86$) |
| Accounted variance ($R^2$) | 34.9% | 45.8% |
| Number of races | 63 | 47 |


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10. In one of our studies, 143 participants were asked to rate the importance of 13 different traits in considering a person for public office. These traits included competence, trustworthiness, likability, and 10 additional traits mapping into five trait dimensions that are generally believed by personality psychologists to explain the structure of personality: extraversion, neuroticism, conscientiousness, agreeableness, and openness to experience (*11*). Competence was rated as the most important trait. The mean importance assigned to competence was 6.65 (SD = 0.69) on a scale

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14. In the studies involving these races, we used photographs of the Democratic and Republican candidates (*12*).
15. In addition, the accuracy of the predictions was not affected by the race and sex of the candidates. This is important because participants might have used race and sex stereotypes to make competence judgments for contests in which the candidates were of different sexes and races. For example, in such contests Caucasian male candidates were more likely to win. However, if anything, competence judgments predicted the outcomes of elections in which the candidates were of the same sex and race (73.1% for the Senate and 68.5% for the House) more accurately than elections in which they were of different sexes and races (67.9% and 64.3%, respectively). This difference possibly reflects participants' social desirability concerns when judging people of different race and sex.
16. For races with more than two candidates, we standardized this difference so that it was comparable to the difference in races with two candidates. Specifically, the difference between the votes of the winner and those of the runner-up was divided by the sum of their votes.
17. From the scatterplot showing the relation between competence judgments and votes for Senate (Fig. 1B), seven races (three in the lower right quadrant and four in the upper left quadrant) could be identified as deviating from the linear trend. It is a well-known fact that incumbents have an advantage in U.S. elections (*18*). In six of the seven races, the incumbent won but was judged as less competent. In the seventh race (Illinois, 2004) there was no incumbent, but the person who won, Barack Obama, was the favorite long before the election. Excluding these seven races, the correlation between competence judgments and differences in votes increased to 0.64 ($P < 0.001$). Although incumbent status seemed to affect the strength of the linear relation between inferences of competence and the margin of victory, it did not affect the prediction of the outcome. Competence judgments predicted the outcome in 72.9% of the races in which the incumbent won, in 66.7% of the races in which the incumbent lost, and in 68.8% of the cases in which there was no incumbent ($\chi^2 < 1.0$ for the difference between these percentages; $P = 0.89$).
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27. For these studies, we used the 2000 and 2002 Senate races (*12*).
28. An additional analysis from a study in which participants made judgments of the candidates for the Senate (2000 and 2002) on 13 different traits [see (*10*) for the list of traits] provided additional evidence that inferences of competence were the key determinants of voting preferences in this situation. We regressed voting preferences on the 13 trait judgments. The only significant predictor of these preferences was the judgment of competence [$\beta = 0.67$, $t(49) = 4.46$, $P < 0.001$].
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34. There is some evidence that judgments of intelligence from facial appearance correlate modestly with IQ scores (*35*). However, these correlations tend to be small [e.g., <0.18 in (*35*)], they seem to be limited to judgments of people from specific age groups (e.g., puberty), and the correlation is accounted for by the judges' reliance on physical attractiveness. That is, attractive people are perceived as more intelligent, and physical attractiveness is modestly correlated with IQ scores.
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# TLR11 Activation of Dendritic Cells by a Protozoan Profilin-Like Protein

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**Mammalian Toll-like receptors (TLRs) play an important role in the innate recognition of pathogens by dendritic cells (DCs). Although TLRs are clearly involved in the detection of bacteria and viruses, relatively little is known about their function in the innate response to eukaryotic microorganisms. Here we identify a profilin-like molecule from the protozoan parasite *Toxoplasma gondii* that generates a potent interleukin-12 (IL-12) response in murine DCs that is dependent on myeloid differentiation factor 88. *T. gondii* profilin activates DCs through TLR11 and is the first chemically defined ligand for this TLR. Moreover, TLR11 is required in vivo for parasite-induced IL-12 production and optimal resistance to infection, thereby establishing a role for the receptor in host recognition of protozoan pathogens.**

Mammalian Toll-like receptors (TLRs) play a fundamental role in the initiation of immune responses to infectious agents through their recognition of conserved microbial molecular patterns (*1*). TLR signaling in antigen-presenting cells, such as dendritic cells (DCs), results in the production of cytokines and costimulatory molecules that are required for initiation of the adaptive immune response (*2*, *3*). Human and mouse TLR family members have been shown to have distinct ligand specificities, recognizing molecular structures such as lipopeptide (TLR2) (*4*), lipopolysaccharide (TLR4) (*5*, *6*), flagellin (TLR5) (*7*), double- and single-stranded RNA (TLR3 and TLR7) (*8*–*11*), and CpG motifs of DNA (TLR9) (*12*). Although several TLRs have been shown to be important for immune responses to microbial products in vitro, their role in host resistance to infection appears to be complex and not