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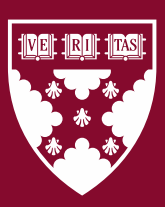
Bushra S. Guenoun
Julian J. Zlatev



Harvard Business School

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*Harvard University*

**Abstract**

Using a combination of exploratory and confirmatory approaches, this research examines how people signal important information about themselves to others. We first train machine learning models to assess the use of warmth and competence impression management strategies in text data. Then, we evaluate whether these signals actually lead to higher warmth and competence perceptions among observers. Guided by these analyses, we generate hypotheses about how individuals present themselves as warm and competent, which we subsequently test in a new dataset. This process allows us to descriptively examine the effective and ineffective strategies people use to manage impressions, providing evidence for the existence of both novel and previously identified tactics. We end by discussing theoretical and practical implications of our findings and highlighting the benefits of an exploratory approach to using natural language processing to examine psychological phenomena.

*Keywords:* warmth, competence, impression management, natural language, psycholinguistics

## Sending Signals: Strategic Displays of Warmth and Competence

"Tell me about yourself." This simple request has been described as the toughest job interview question due to the seemingly-infinite number of ways one can respond (Schwartzberg, 2019). If an individual wants to convey their competence, they might discuss their accomplishments and leadership skills; if they instead want to emphasize their warmth, they might share information about their personal values and hobbies.

While it is clear that people might try to strategically vary how they present themselves in order to create a certain impression with their audience (e.g., Bolino & Turnley, 2003; Jones & Pittman, 1982), explorations into how such responses vary have been largely limited to the use of top-down approaches where researchers identify and examine the use of one or a handful of strategies at a time (see Steinmetz, Sezer, & Sedikides, 2017 for a review). Although this work has produced a multitude of helpful insights into how individuals influence others' perceptions of them, it is fundamentally limited by the characteristics of the chosen research strategy. Namely, like the vast majority of social psychology research (Rozin, 2001), these studies involve the *a priori* selection of a hypothesis to test or a phenomenon to study, which can fall prey to issues such as path dependence of prior work and researcher beliefs about the world.

Acknowledging these limitations raises the important question of whether other impactful impression management strategies remain unexplored. Given that work on impression management has both prescriptive (e.g., providing job-seekers with advice on how to present themselves in interviews, Lebowitz, 2015) and explanatory (e.g., identifying when people are engaging in impression management, Wayne & Liden, 1995) implications, the oversight of influential impression management strategies could have considerable ramifications for theory and practice.

The present work takes a combined exploratory and confirmatory approach to begin to address this question. Our approach employs over seven hundred natural language features to train machine learning models that can assess the use of impression management strategies in text data. Unlike self-report measures, which require many researcher and participant assumptions (Nisbett & Wilson, 1977, Paulhus & Vazire, 2007), text data is rich and less encumbered by researcher inferences and design.[1] After inductively exploring which impression management strategies appear useful (and which are used erroneously), we then test a subset of these hypotheses using a new dataset. In doing so, we are able to both descriptively examine the natural strategies people use to manage impressions, as well as provide confirmatory evidence for the existence of both novel and previously-identified tactics.

**The Ubiquity of Impression Management**

Individuals engage in self-presentation and impression management in virtually all social interactions (Goffman, 1978; Jones & Pittman, 1982; Vohs, Baumeister & Ciarocco, 2005). As people navigate different social situations, they often shift how they present themselves in order to meet their self-presentation goals (Liljenquist, 2010). Research finds that the use of impression management techniques is associated with a multitude of interpersonal benefits including more positive judgements by others (Schlenker & Weigold, 1992), increased perceptions of similarity (Wayne & Liden, 1995), and increased trust (Dufner et al., 2012). Impression management use is also positively correlated with hiring (DePaulo, 1992) and professional success (Wayne & Liden, 1995). In this paper, we define self-presentation (and, hence, impression management) as explicit or implicit attempts to manage how one is perceived by others (Bolino & Turnley, 2003; Jones & Pittman, 1982; Leary & Kowalski, 1990).

[1] It is important to note that no research method is entirely independent of researcher influence, a point we return to in the General Discussion.

**Warmth & Competence in Impression Formation**

Warmth—defined by traits like fairness, generosity, helpfulness, honesty, sincerity, tolerance, and understanding—and competence—defined by traits such as cleverness, creativity, effectiveness, foresightedness, ingenuity, intelligence, and being knowledgeable—are widely viewed as the two primary dimensions of interpersonal perception and evaluation (Cuddy, Fiske, & Glick, 2008). Impressions about individuals along these two dimensions are made nearly instantaneously (Cuddy, Glick & Beninger, 2011), and they predict a variety of important outcomes, including cooperation (Cuddy, Fiske, & Glick, 2007), hiring decisions (Rudman & Glick, 1999; Casciaro & Lobo, 2005), and voting behaviors (Todorov, Mandisoza, Goren & Hall, 2005; Castelli, Carraro, Ghitti & Pastore, 2009).

Although research suggests that impression management efforts primarily target warmth and competence perceptions (Cuddy, Glick & Beninger, 2011; Liljenquist, 2010), work in this area has focused on the utilization and effectiveness of explicit, intentional impression management tactics, such as ingratiation or supplication (Stevens & Kristof, 1995; Jones & Pittman, 1982), rather than on how warmth and competence are signaled.

Most research on how warmth and competence are signaled is in the domain of nonverbal behavior (Cuddy, Glick & Beninger, 2011). This work has identified behaviors such as eye contact, nodding and smiling as indicating warmth and expanding one's body as indicating competence (Surakka & Hietanen, 1998; Carli, LaFleur, & Loeber, 1995; Carney, Hall, & Smith LeBeau, 2005; Weisfeld & Beresford, 1982). Recently, some work has begun to explore warmth and competence signaling in language. However, this work has typically examined specific word choices and how they are evaluated by others (e.g., Decter-Frain & Frimer, 2016; Dupree & Fiske, 2019; Pietraszkiewicz et al, 2018; Nicolas, Bai & Fiske, 2022). Communication research

suggests that language attributes independent of content (e.g., phonology, syntax and lexicon) influence perceptions and evaluations of the communicator, such that two messages can contain the same content, but be perceived very differently (Bradac, Bowers & Courtright, 1979; Miller, Lane, Deatrik, Young & Potts, 2007; Pan, McNamara, Lee, Haleblian & Devers, 2018; Pornpitakpan, 2004). As a result, the exclusive focus on the content of the language being used does not take into account the potential importance of how language is organized or structured (Kennedy, Ashokkumar, Boyd & Dehghani, 2021), narrowing the scope of impression management strategies that can be studied.

**Accuracy in Impression Management**

It is not uncommon for individuals to experience relational misperceptions where one's assessment of how another perceives their relationship significantly differs from how one actually understands their relationship (Byron & Landis, 2020). For example, people often make mistakes in their judgements of how much others trust them and consider them a friend (Byron & Landis, 2020).

There are two main reasons why an individual's attempt at cultivating a given impression may not be successful. First, they may be using too much or too little of the impression management strategy, possibly as a result of depleted regulatory resources (Gordon, 1996; Turnley & Bolino, 2001; Vohs, Baumeister & Ciarocco, 2005). Second, they may be using a signal that they believe expresses a given impression, when in reality it does not. Most of the research on failed impression management has focused on the first type of failure because of the assumption that people are generally capable of accurately assessing how their behavior influences others' judgements (Baumeister, 1982; Leary & Allen, 2011; Van Boven, Kruger, Savitsky, Gilovich, 2000). However, recent findings have called this assumption into question,

finding that people often misunderstand how certain behaviors will be perceived by others (Steinmetz, Sezer, & Sedikides, 2017). For example, perceivers show more liking for individuals who attribute their success to hard work rather than to natural talent. However, communicators fail to predict perceivers' preferences and publicly attribute their success to natural talent more than perceivers find suitable (Steinmetz, 2018). Similarly, communicators believe that perceivers will view their mistakes more negatively than they actually do (Savitsky, Epley, & Gilovich, 2001).

These findings suggest that warmth and competence signaling through language may not always be optimal or accurate.[2] In this paper, we explore how people systematically make errors in their management of warmth and competence impressions.

**Linguistic Analysis of Impression Management**

Although there is little work on how individuals vary their language in order to convey warmth and competence to others, impression management researchers have explored the role of language in the formation and perception of other types of impressions, such as trustworthiness. Using the popular Linguistic Inquiry and Word Count (LIWC) dictionaries (Pennebaker, Boyd, Jordan & Blackburn, 2015), researchers found that lying, relative to truth-telling, was associated with the showcase of less cognitive complexity, the use of fewer self- and other-references, and the use of more negative words (Newman, Pennebaker, Berry, Richards, 2003). Another study, also using the LIWC dictionaries, found that deception in online dating profiles is associated with the use of first-person singular pronouns and negation terms. Interestingly, the communicator does not intentionally signal their dishonesty with these cues and perceivers do

[2] In this paper, accuracy refers to the extent to which an individual's attempt to impression manage competence and warmth are successful, not the extent to which the signal expresses an individual's actual levels of competence and warmth. In other words, a signal is accurate if it is perceived as the impression manager intended (and inaccurate if it is not), regardless of whether it expresses the impression manager's true qualities.

not use them to assess whether or not the communicator is trustworthy (Toma & Hancock, 2012).

The majority of these studies found interesting and fruitful linguistic trends in impression management by utilizing exploratory methods where no a priori hypotheses were set (e.g., Berry, Hiller, Mueller & Pennebaker, 1997; Pennebaker & Stone, 2003). We take a similar approach to exploring how language is used to accurately or inaccurately signal competence and warmth.

**Present Research**

The rest of this paper proceeds in four stages. In Stage 1, we built and pre-registered a repository of over seven hundred natural language processing (NLP) features. In Stage 2, we used machine-learning models to explore how individuals signal competence and warmth in natural language and examine whether these signals are accurate or inaccurate predictors of competence and warmth perceptions. Guided by our quantitative findings, we qualitatively analyzed the introductions and generated hypotheses about how individuals strategically present themselves as competent and warm in Stage 3. In Stage 3, we also discuss potential interpretations of these results and outline links to previous work. In Stage 4, we tested a subset of these hypotheses on a new dataset. Both Stages 2 and 4 were pre-registered on OSF (https://osf.io/nr9ta/?view_only=320f981e2efc49e08ae026a57b0a37d6).

## Stage 1: Development of Feature Repository

Given the exploratory nature of our research, we did not want feature development to be tied to existing theories on competence and warmth. Instead, we wanted to cast a very wide net with the goals of uncovering novel insights. Accordingly, we started the development of a feature repository by conducting a literature search into the different methods used to analyze natural language. We began by aggregating features from well-known text analysis tools,

including Linguistic Inquiry and Word Count (LIWC; Pennebaker, Booth, Boyd & Francis, 2015) and the Quanteda R Package (Benoit et al., 2018). Then, we searched for peer-reviewed research articles that used text analysis. We focused this search on websites that aggregate different peer-reviewed dictionaries that have been used for text analysis, namely the Textual Affective Properties Analyzer (TAPA; Boyd, 2017) and CAT Scanner (McKenny, Short & Newman, 2012). In addition, we searched for social science articles on Google Scholar using terms such as "text analysis," "natural language processing", "dictionary", and "wordlist." We stopped our search once we reached saturation (i.e., we were no longer coming across new linguistic tools to include in our feature repository).

We also created additional features to augment those collected through our literature search. First, we used English Language Learner websites (e.g., 7ESL.com; EnglishClub.com) to create wordlists associated with different concepts, such as hobbies, education, and employment. We also created features that assessed whether some of the most commonly-used verbs and adjectives expressed competence and warmth. These features were built using an independent judge's indications of whether each word was positively (+1), negatively (-1), or not related (0) to competence and warmth (see OSF Repository for wordlist with judge ratings).

Second, we used spacyR (Benoit & Matsuo, 2022), an R wrapper for the Python spaCy package (Honnibal & Montani, 2017), which provides tools that parse the grammatical structure of text to systematically build features that assess language construction. We initially began by creating features that assessed the instances of each part of speech, both at the introduction level and at the sentence level. Then, we developed features to capture how each part of speech is related to the subject and the main verb at the sentence level. Additionally, we developed features that assessed the distance between the main elements of a sentence, including the

subject, object, and verbs. We also created features assessing potentially important linguistic qualities, including phrase lengths and instances where sentences started with pronouns. Finally, we used spacyR to examine pronoun usage and placement, given the highlighted importance of pronouns in previous research (e.g., Campbell & Pennebaker, 2003).

At the end of this process, our repository contained 733 features, 393 of which were aggregated through the literature search and 340 of which were developed by the authors (See OSF Repository for feature list and operationalizations). Note that, as a result of erring on the side of completeness, we sometimes included multiple measures for similar constructs. For example, we have multiple different ways of capturing lexical diversity (Benoit et al., 2018), including Herdan's C (Herdan, 1960, as cited in Tweedie & Baayen, 1998), Simpson's D (Simpson, 1949, as cited in Tweedie & Baayen, 1998), and Yule's K (Yule, 1944, as cited in Tweedie & Baayen, 1998).

There are four different types of features in our repository. The first type contains count-based dictionary features, or features that count the number of times a predetermined list of words appear in a piece of text. For example, a feature developed to assess affirmation might count the occurrences of words such as “yes” or “okay.” The second type contains score-based word list features, or features that assess a construct by assigning different scores to words or phrases depending on how closely they map on to the focal construct. For instance, a feature developed to assess happiness might assign words like “sunshine” with a high happiness score and words like “darkness” with a low happiness score. If a text contains more words like “sunshine” compared to words like “darkness,” then the average happiness score of the text will be higher. The third type of features moves beyond lists of words and instead assesses

characteristics of the text itself. For example, a feature might look at the average number of words or syllables in a sentence to understand text diversity and readability.

Unlike the first three feature types, which focus on the content of text, the fourth type analyzes how different elements of a sentence relate to one another (i.e., the structure of the text). For example, a feature developed to understand the relationship between first-person pronouns and verbs might compare the number of times first-person pronouns appear before (versus after) the main verb of a sentence.

## Stage 2: Exploratory Test of Features Associated With Competence and Warmth

The goal of Stage 2 was to use the feature repository developed in Stage 1 to explore the use and effectiveness of competence and warmth signals in language. To do so, we asked participants to write an introduction about themselves. Participants were randomly assigned to present themselves as particularly competent, particularly warm, or no additional goal was given. We then used supervised machine-learning models to determine which features are most predictive of competence and warmth signaling. Finally, we had a panel of independent judges assess the effectiveness of the competence and warmth signaling.

### Method

#### *Participants*

**Text Writers**. We collected our own corpus of introductions to develop our models, rather than relying on pre-existing text datasets. We did this in order to randomly assign people to different self-presentational goals (described in more detail below). Specifically, we recruited 900 participants located in the United States through Prolific Academic to complete a five-minute survey for $0.80. Given that effect sizes cannot be calculated for supervised machine learning models as there is no hypothesis testing, our sample size was determined by the data

requirements for similar previous models (e.g., Authors, 2022). As pre-registered, we excluded 10 participants whose writing was copied from the internet, which left us with 890 participants ($M_{age}$ = 37.6 years, $SD_{age}$ = 13.1; Table 1 presents the gender and race breakdowns for these participants).

**Table 1**

*Demographic Breakdown of Samples*

| | | Stage 2: Writers | Stage 2: Evaluators | Stage 4: Writers | Stage 4: Evaluators |
|---|---|---|---|---|---|
| Gender | | | | | |
| | Female | 51.5% | 56.6% | 48.6% | 49.0% |
| | Male | 48.3% | 42.0% | 49.7% | 49.9% |
| | Other | 0.2% | 1.3% | 1.7% | 1.1% |
| Race | | | | | |
| | White | 76.4% | 79.6% | 76.6% | 80.1% |
| | Asian | 12.0% | 9.8% | 11.8% | 9.5% |
| | Black | 8.8% | 8.4% | 8.8% | 8.2% |
| | Hispanic or Latino | 6.6% | 6.9% | 8.4% | 6.5% |
| | American Indian or Alaska Native | 1.1% | 1.5% | 1.4% | 1.6% |
| | Native Hawaiian or Pacific Islander | 0.2% | 0.1% | 0.5% | 0.3% |

*Note.* Race categories are non-mutually exclusive

**Text Evaluators.** To evaluate the introductions, we recruited another 897 participants located in the United States to complete a seven-minute survey for $1.23.[3] As pre-registered, four participants were excluded because they failed the required English language comprehension check at the beginning of the study, two were excluded because they did not receive introductions to evaluate during the study due to technical difficulties, and one was excluded because the introductions they received were already evaluated by other participants, leaving 890 participants ($M_{age}$ = 40.3 years, $SD_{age}$ = 15.1; Table 1 presents the gender and race breakdowns for these participants).

***Design***

**Text Writers**. Writers were randomly assigned to one of three conditions: competence, warmth, and control. After consenting to take part in the study, writers completed a pre-writing task in which those in the competence and warmth conditions were instructed to "Imagine you were asked to judge whether someone was a [competent/warm] person using a short "about me" introduction that they wrote. What types of information or signals would you be looking for to evaluate whether that person was [competent/warm]?" This was to prime participants to strategically present themselves as [competent/warm]. Those in the control condition were also asked to "Imagine you were shown a short "about me" introduction that a person wrote. What types of information or signals would you expect in that introduction?" All writers had to list at least five signals, but they had space to write up to ten.

[3] Our original pre-registration reports that we will use two human judges to provide these introduction evaluations. This was done in a previous iteration of the study (see OSF Repository for the method, results, and conclusions of these analyses). However, as pointed out by reviewers, using evaluations from only two judges limited the ability to draw strong conclusions. As a result, we pre-registered and collected introduction evaluations from a larger sample. Encouragingly, our conclusions are similar regardless of which evaluation dataset we use.

After the initial pre-writing task, writers were told to write a short introduction about themselves that would be shown to other Prolific workers. Those in the competence and warmth conditions were also provided with the following additional instructions: "Your goal is to present yourself as a [competent/warm] person. In other words, you want to write an introduction so that others describe you as [competent/warm]." Participants were required to write at least 250 characters. Then, participants reported their gender, age and race.

These introductions were deidentified by the research team before they were evaluated by other Prolific participants to protect participant privacy[4]. Deidentification included replacing all letters in people's names with underscores except for the first letter and replacing all Prolific IDs with underscores. For example, Jane Doe was deidentified as "J___ D__." This method was selected because we wanted to retain the word count and character count of the original introductions.

**Evaluations Collection.** After consenting to take part in the study, evaluators were asked to respond to an English language comprehension check question: "Which of the following words has the closest meaning to the following word? Upset" (answer choices: ice, desk, pen, book, sad, cheerful). Evaluators could not complete the survey if they failed the comprehension check. If they answered the comprehension check successfully, they were randomly assigned to evaluate six of the 890 introductions. Evaluators were asked to read and evaluate one introduction at a time.

After reading the introduction, evaluators responded to the following question: "What stands out to you most about this Prolific worker? Please use your own words." This question

[4] Deidentification was required by our Institutional Review Board but it was not pre-registered. Accordingly, we also models trained on the identified messages (see OSF Repository for these models).

was meant to ensure evaluators were spending enough time with the introduction before they evaluated competence and warmth.

Evaluators were asked to respond to the following questions to evaluate [competence/warmth]: "Compared to the average Prolific worker, how [COMPETENT/WARM] is the Prolific worker that wrote the introduction above?" (7-point scales; Competence: 1 = "Extremely incompetent" to 7 = "Extremely competent"; Warmth: 1= "Extremely cold" to 7 = "Extremely warm"). To make these evaluations, evaluators were provided with descriptions of competence ("Competence includes traits like cleverness, creativity, effectiveness, foresightedness, ingenuity, intelligence, and being knowledgeable") and warmth ("Warmth includes traits like fairness, generosity, helpfulness, honesty, sincerity, tolerance, and understanding"). Each introduction received six evaluations of competence and warmth and reliability was moderate ($ICC_{competence}$ = .58; $ICC_{warmth}$ = .69). At the end of the survey, evaluators reported their gender, age, and race.

***Analysis Plan***

Our analysis plan for this stage consisted of three steps: exploration of signaling, examination of signaling effectiveness, and qualitative determination of signaling strategies.

**Step 1: Exploration of Signaling.** Our research uses supervised machine learning models to generate hypotheses about how competence and warmth are signaled and perceived in natural language. More specifically, lasso (least absolute shrinkage and selection operator) regression models were used to determine which of the 733 natural language processing (NLP) features in our repository were most predictive of competence and warmth signaling.[5] Lasso

[5] Our research utilizes lasso models for hypothesis generation rather than predictive model development. As a result, we do not report model performance in the main paper. See Supplementary Materials for these results. Readers interested in competence and warmth predictive models can refer to the warmthcompetence R package which estimates competence and warmth perceptions of written language (Authors, 2022).

models are a form of penalized regression models that determine which features are the most predictive of an outcome variable by shrinking the coefficients of the least predictive features to zero (see Tibshirani, 1996 for more details on lasso regressions). We performed a 10-fold cross validation procedure to fit models using the caret R package (Kuhn, 2008).[6]

To understand competence signaling, we analyzed data from the competence condition and the control condition such that the dependent variable was condition (competence or control) and the independent variables were the 733 NLP features. This method allowed us to examine which NLP features most predicted the linguistic differences between the introductions in the competence condition and the control condition (similar to prediction methods used in Jeong, Minson, Yeomans & Gino, 2019). Any features with non-zero coefficients were considered lasso features that captured competence signaling.

Given that we are interested in the utility of each feature independently (rather than the model in aggregate), we ran a series of linear regressions to confirm that each of the lasso features with non-zero coefficients showed significant differences between the competence and control conditions ($p < 0.05$). In these regressions, condition was the independent variable and the feature was the dependent variable. Any feature that both had a non-zero coefficient in the lasso model and showed significant differences between the competence and control conditions in subsequent linear regressions was identified as a competence signaling feature. The same process was used to understand warmth signaling using the data from the warmth condition and the control condition.

[6] Due to a typo, we unintentionally pre-registered a 100-fold cross validation procedure instead of a 10-fold cross validation procedure. For completeness, we include the results from a 100-fold cross validation in our OSF Repository. The features are similar to those reported.

**Step 2: Examination of Signaling Effectiveness.** To understand the effectiveness of competence [warmth] signaling, we examined whether evaluator ratings of competence [warmth] predicted each of the competence [warmth] signaling features. We ran a series of linear regressions where the average evaluator competence [warmth] rating was the independent variable and the competence [warmth] feature was the dependent variable.

If a competence [warmth] feature was significantly predicted by the average evaluator competence [warmth] rating and the predictions were in the same direction as the model (both coefficients are positive or both are negative), then the feature was identified as an *accurate signal of competence [warmth].* If a feature was significantly predicted by the average evaluator competence [warmth] rating and the predictions were in the opposite direction as the model (one coefficient was positive while the other was negative), the feature was identified as an *inaccurate signal of competence [warmth].* If the average evaluator competence [warmth] rating did not predict the feature, we classified the results as inconclusive; that is, there was not enough evidence to identify that feature as accurate or inaccurate.

**Step 3: Qualitative Determination of Signaling Strategies.** Given that the features used to analyze the introductions were not created for the purpose of examining competence and warmth signaling, post-hoc qualitative analyses were required to understand what each feature was assessing in our dataset. For example, many of the features we developed capture particular constructions of text, such as the number of instances in which a pronoun appears after the main verb of a sentence. Through qualitative post-hoc analyses, we found that participants most commonly placed a pronoun after the main verb of a sentence when they were making declarations about their positive traits. Even previously tested and validated features—such as the LIWC feature assessing language related to visual perception (Pennebaker et al., 2015)—

require interpretation. For example, we find that visual perception language is regularly used when participants are referencing passive activities such as watching television or playing video games. Given their exploratory nature, these post-hoc qualitative analyses were not pre-registered. We also conducted pre-registered post-hoc quantitative analyses in which we asked three independent judges to make judgements about whether or not particular strategies were used in each introduction (see Supplementary Materials).

In Stage 3 we continued these post-hoc analyses to develop hypotheses about how individuals accurately and inaccurately signal competence and warmth in strategic self-presentation.

## Results

### *Competence Signaling*

Following our pre-registered analysis plan, we trained a lasso model to determine which of our NLP features are most predictive of competence signaling in natural language. Our model compared participants' language use in the competence signaling condition against that of the control condition to understand how people alter their self-presentational language in order to convey impressions of competence.

**Table 2**

*Competence Signals*

| Feature | Lasso Model Coefficient | Participant Condition (Control - Competence) | Evaluator Competence Ratings | Accurate Competence Signal (Y/N) | Source |
|---|---|---|---|---|---|
| ***Features Positively Related to Competence Condition*** | | | | | |
| Achievement-Related Language | 0.214 | 0.337*** | 0.112*** | Y | Pennebaker et al. (2015) |
| Work-Related Language | 0.17 | 0.341*** | 0.324*** | Y | Pennebaker et al. (2015) |
| Power References (Measure 1) | 0.144 | 0.238*** | 0.061 | N/A | Pennebaker et al. (2015) |
| Achievement Identity Markers | 0.113 | 0.174*** | 0.250*** | Y | Author Developed |
| Readability Index (Measure 1) | 0.095 | 0.271*** | 0.127*** | Y | Rinker (2020) |
| Acknowledgement | 0.094 | 0.136*** | -0.05 | N/A | Yeomans et al. (2018) |
| Average Sentiment | 0.087 | 0.194*** | -0.016 | N/A | Rinker (2019) |
| "I" Focus | 0.084 | 0.125** | 0.071* | Y | Author Developed |
| Decreased Use of Superlative Adjectives | 0.081 | 0.236*** | 0.061 | N/A | Author Developed |
| Lexical Uniformity | 0.077 | 0.081* | -0.075* | N | Benoit et al. (2018) |
| Clausal Complements | 0.077 | 0.177*** | -0.165*** | N | Author Developed |
| Certainty-Related Language | 0.077 | 0.171*** | -0.171*** | N | Pennebaker et al. (2015) |
| Age of Acquisition | 0.065 | 0.265*** | 0.089** | Y | Kuperman et al. (2012) |
| Readability Index (Measure 2) | 0.06 | 0.255*** | 0.246*** | Y | Rinker (2020) |
| Complex Sentences | 0.049 | 0.192*** | 0.153*** | Y | Author Developed |
| Competent Verbs & Adjectives | 0.036 | 0.267*** | -0.004 | N/A | Author Developed |
| Conscientious Words | 0.033 | 0.188*** | 0.003 | N/A | Payne et al. (2011) |
| Integrity Words | 0.032 | 0.101* | -0.096** | N | Payne et al. (2011) |
| Insight-Related Language | 0.029 | 0.238*** | -0.011 | N/A | Pennebaker et al. (2015) |
| Causation-Related Language | 0.028 | 0.199*** | -0.013 | N/A | Pennebaker et al. (2015) |
| Negative Sentiment | 0.026 | 0.095 | 0.172*** | N/A | Jockers (2017); Hu & Liu (2004) |
| Touch Imagery | 0.022 | 0.105* | 0.023 | N/A | Martindale (1975) |

| | | | | | |
|---|---|---|---|---|---|
| Declarations about One's Positive Traits | 0.015 | 0.178*** | -0.182*** | N | Author Developed |
| Explicit Declarations of Competence | 0.015 | 0.160*** | -0.078* | N | Payne et al. (2011) |
| Filler Discourse Markers | 0.011 | 0.176*** | -0.126*** | N | Author Developed |
| Power References (Measure 2) | 0.006 | 0.172*** | 0.102** | Y | Stone et al. (1966) |
| Semicolons | 0.001 | 0.053 | 0.012 | N/A | Pennebaker et al. (2015) |
| Existential "There" | <0.001 | -0.063 | 0.001 | N/A | Author Developed |
| ***Features Negatively Related to Competence Condition*** | | | | | |
| Punctuation Use | -0.141 | -0.251*** | -0.003 | N/A | Pennebaker et al. (2015) |
| Warm Verbs & Adjectives | -0.114 | -0.154*** | -0.192*** | Y | Author Developed |
| Social Relationship References | -0.109 | -0.204*** | -0.155*** | Y | Pennebaker et al. (2015) |
| Food References | -0.108 | -0.250*** | -0.022 | N/A | Pennebaker et al. (2015) |
| Leisure References | -0.102 | -0.270*** | 0.011 | N/A | Pennebaker et al. (2015) |
| Television & Video Games References | -0.092 | -0.210*** | -0.092** | Y | Pennebaker et al. (2015) |
| Simple Self-Descriptions | -0.079 | -0.196*** | 0.110*** | N | Author Developed |
| Proper Nouns | -0.069 | -0.246*** | 0.004 | N/A | Author Developed |
| Noun Phrase as Adverbial Modifier | -0.054 | -0.167*** | -0.061 | N/A | Author Developed |
| Negation (Measure 1) | -0.046 | -0.107** | -0.233*** | Y | Author Developed |
| Run-on Sentences | -0.045 | -0.102* | -0.076* | Y | Author Developed |
| Revision Discourse Markers | -0.038 | -0.107** | -0.090** | Y | Alemany (2005) |
| Hobby Words | -0.034 | -0.241*** | 0.073* | N | Author Developed |
| Anxiety-Related Language | -0.03 | -0.101* | -0.076* | Y | Pennebaker et al. (2015) |
| Cold Imagery | -0.029 | -0.141*** | 0.034 | N/A | Martindale (1975) |
| Passive Auxiliary Verbs | -0.028 | -0.087* | -0.036 | N/A | Author Developed |
| Motion References | -0.022 | -0.148*** | -0.034 | N/A | Pennebaker et al. (2015) |
| Object Predicate | -0.019 | -0.100* | 0.015 | N/A | Author Developed |
| Joy | -0.019 | -0.200*** | -0.116*** | Y | Rinker (2019) |
| Expletives | -0.018 | -0.063 | -0.003 | N/A | Author Developed |
| References to the Unknown | -0.018 | -0.072 | -0.022 | N/A | Martindale (1975) |
| Number of Sentences (Measure 1) | -0.017 | -0.166*** | -0.061 | N/A | Rinker (2020) |

| | | | | | |
|---|---|---|---|---|---|
| Male References | -0.007 | -0.143*** | -0.006 | N/A | Pennebaker et al. (2015) |
| Number of Sentences (Measure 2) | -0.005 | -0.166*** | -0.061 | N/A | Rinker (2020) |
| Adverbs After Main Subject | -0.003 | -0.170*** | -0.022 | N/A | Author Developed |
| Negation (Measure 2) | -0.003 | -0.101* | -0.206*** | Y | Rinker (2013) |
| Affect | -0.001 | -0.113** | -0.155*** | Y | Pennebaker et al. (2015) |
| Number of Sentences (Measure 3) | <0.001 | -0.173*** | -0.091** | Y | Author Developed |

*Note*. Regression coefficients are standardized (columns 3,4,6,7). * $p < .05$, ** $p < .01$, *** $p < .001$. The third column is produced by running a series of regressions (one for each feature) where condition (control or competence) is the independent variable and the feature is the dependent variable. The fourth column is produced by running a series of regressions (one for each feature) where the judge competence ratings are the independent variable and the feature is the dependent variable. Features in the repository but not in the table had zero coefficients in the lasso model, indicating that they were least predictive of competence signaling. See OSF Repository for operationalizations of the features.

As shown in Table 2, our model found 56 linguistic features that predicted whether a given participant was in the competence signaling condition or the control condition. As pre-registered, we also ran linear regression models that confirmed that participant condition (competence-signaling versus control) predicted variance in 51 of these features (see Table 2). Refer to the Supplementary Materials for more details on each of these features.

Next we regressed each of the 51 competence features onto the average evaluator ratings of competence to examine whether the features that participants used to signal competence were accurate or inaccurate signals of competence. As shown on Table 2, 21 of the 51 features were accurate signals of competence, meaning that how participants altered their use of these features between the control condition and the competence signaling condition *accurately* expressed competence to observers.

Nine of the 51 features were inaccurate signals of competence, meaning that how participants altered their use of these features between the control condition and the competence signaling condition *inaccurately* expressed competence to observers. Twenty-one of the 51 features were not significantly predicted by judge ratings of competence. Given difficulties associated with interpreting insignificant results, these features were not labeled as accurate or inaccurate signals of competence.

***Warmth Signaling***

Replicating the methodology used to explore competence signaling, we trained a lasso model to determine which of our NLP features are most predictive of warmth signaling in natural language by comparing participants' language use in the warmth signaling condition against that of the control condition to understand how people alter their self-presentational language in order to convey impressions of warmth.

As shown on Table 3, our model found 63 linguistic features that predicted whether the participant was in the warmth signaling condition or the control condition. Linear regression models confirmed that 53 of these features predicted variance between the warmth signaling condition and the control condition (see Table 3).

Then we regressed each of the 53 warmth features onto the average evaluator ratings of warmth to examine whether the features that participants used to signal warmth were accurate or inaccurate signals of competence. As shown on Table 3, 26 of the 53 features were accurate signals of warmth, meaning that how participants altered their use of these features between the control condition and the warmth signaling condition *accurately* expressed warmth to observers.

Only one of the features, female references, was an inaccurate signal of warmth, meaning that how participants altered their use of female references between the control condition and the warmth signaling condition *inaccurately* expressed warmth to observers. Twenty-six features were not significantly predicted by evaluator ratings of warmth. Given difficulties associated with interpreting insignificant results, these features were not labeled as accurate or inaccurate signals of warmth.

**Table 3**

*Warmth Signals*

| Feature | Lasso Model Coefficient | Participant Condition (Control - Warmth) | Evaluator Warmth Ratings | Accurate Warmth Signal (Y/N) | Source |
|---|---|---|---|---|---|
| ***Features Positively Related to Warmth Condition*** | | | | | |
| Exclamation Marks | 0.362 | 0.267*** | 0.273*** | Y | Pennebaker et al. (2015) |
| Social Relationship References | 0.292 | 0.383*** | 0.339*** | Y | Pennebaker et al. (2015) |
| Open Clausal Complements | 0.269 | 0.283*** | 0.118*** | Y | Author Developed |
| Community-Related Language | 0.206 | 0.241*** | 0.052 | N/A | Pencle & Malaescu (2016) |
| Introspection (Measure 1) | 0.201 | 0.153*** | 0.080* | Y | Author Developed |
| Positive Emotion | 0.166 | 0.340*** | 0.266*** | Y | Pennebaker et al. (2015) |
| Friendship-Related Language | 0.136 | 0.222*** | 0.166*** | Y | Pennebaker et al. (2015) |
| Filler Discourse Markers | 0.127 | 0.257*** | 0.039 | N/A | Author Developed |
| Certainty-Related Language | 0.118 | 0.282*** | 0.017 | N/A | Pennebaker et al. (2015) |
| Average Sentence Sentiment | 0.117 | 0.291*** | 0.06 | N/A | Rinker (2020) |
| Submission-Related Words | 0.098 | 0.198*** | 0.042 | N/A | Stone et al. (1966) |
| Clausal Complements | 0.081 | 0.315*** | 0.038 | N/A | Author Developed |
| Introspection (Measure 2) | 0.074 | 0.326*** | 0.079* | Y | Author Developed |
| Mental Verbs | 0.064 | 0.264*** | 0.129*** | Y | Author Developed |
| Relative Pronouns | 0.063 | 0.261*** | 0.070* | Y | Pennebaker et al. (2015) |
| Sentiment | 0.056 | 0.270*** | 0.083* | Y | Rinker (2019) |
| Third Person Plural Pronouns | 0.055 | 0.288*** | 0.137*** | Y | Pennebaker et al. (2015) |
| Psychological Drives | 0.052 | 0.222*** | 0.089** | Y | Pennebaker et al. (2015) |
| First Person Pronoun as Object | 0.050 | 0.219*** | 0.057 | N/A | Author Developed |
| Third Person Singular Present Verbs | 0.047 | 0.103* | 0.141*** | Y | Author Developed |
| Chaos-Related Imagery | 0.046 | 0.086* | 0.012 | N/A | Martindale (1975) |

| | | | | | |
|---|---|---|---|---|---|
| Power References | 0.042 | <0.001 | -0.144*** | N/A | Pennebaker et al. (2015) |
| Amplification Words | 0.038 | 0.161*** | >-0.001 | N/A | Rinker (2013) |
| Round Brackets | 0.038 | 0.027 | 0.047 | N/A | Author Developed |
| Adverbial Clause Modifier | 0.035 | 0.244*** | 0.063 | N/A | Author Developed |
| Question Marks | 0.035 | 0.136*** | 0.067* | Y | Pennebaker et al. (2015) |
| Happiness | 0.029 | 0.421*** | 0.173*** | Y | Dodds et al. (2011) |
| Giving Agency | 0.029 | 0.095* | -0.06 | N/A | Yeomans et al. (2018) |
| Infinitive “To” | 0.026 | 0.158*** | 0.077* | Y | Author Developed |
| Lexical Diversity | 0.026 | 0.148*** | 0.208*** | Y | Rinker (2020) |
| Touch Imagery | 0.025 | 0.096* | 0.009 | N/A | Martindale (1975) |
| Second Person Pronouns | 0.024 | 0.233*** | 0.087** | Y | Author Developed |
| Personal Pronouns Before Main Subject | 0.022 | 0.214*** | 0.065 | N/A | Author Developed |
| Use of "You" or "We" | 0.020 | 0.185*** | 0.132*** | Y | Author Developed |
| Acknowledgement | 0.018 | 0.132** | 0.013 | N/A | Yeomans et al. (2018) |
| Quotation Marks | 0.013 | 0.076 | 0.032 | N/A | Pennebaker et al. (2015) |
| Agent | 0.009 | 0.051 | 0.001 | N/A | Author Developed |
| Impersonal Pronouns | 0.006 | 0.309*** | 0.019 | N/A | Yeomans et al. (2018) |
| Auditory Perceptual Strength | 0.006 | 0.130* | 0.075 | N/A | Lynott & Connell (2009) |
| Declarations About One's Positive Traits | 0.004 | 0.392*** | 0.059 | N/A | Author Developed |
| ***Features Negatively Related to Warmth Condition*** | | | | | |
| Starting Sentences with "I" | -0.318 | -0.295*** | -0.055 | N/A | Author Developed |
| Readability Index | -0.295 | -0.293*** | -0.276*** | Y | Benoit et al. (2018) |
| Number of Statements | -0.212 | -0.280*** | -0.088** | Y | Pennebaker et al. (2015) |
| Economic Words | -0.207 | -0.296*** | -0.171*** | Y | Moss et al. (2016) |
| Work-Related Language | -0.144 | -0.282*** | -0.283*** | Y | Pennebaker et al. (2015) |
| Numerical Modifiers (Measure 3) | -0.094 | -0.338*** | 0.003 | N/A | Author Developed |
| Numerical Modifiers (Measure 2) | -0.089 | -0.341*** | 0.007 | N/A | Author Developed |
| Datives | -0.084 | 0.012 | 0.005 | N/A | Author Developed |
| Passive Voice | -0.071 | -0.140*** | -0.074* | Y | Author Developed |

| | | | | | |
|---|---|---|---|---|---|
| Hobby Words | -0.067 | -0.232*** | 0.061 | N/A | Author Developed |
| Interjections | -0.055 | -0.067 | -0.04 | N/A | Author Developed |
| Sex-Related Imagery | -0.048 | -0.103* | 0.026 | N/A | Martindale (1975) |
| Female References | -0.047 | -0.096* | 0.146*** | N | Pennebaker et al. (2015) |
| Water-Related Imagery | -0.034 | -0.102* | 0.005 | N/A | Martindale (1975) |
| Negation | -0.033 | 0.018 | -0.137*** | N/A | Yeomans et al. (2018) |
| Low Power | -0.032 | -0.170*** | 0.022 | N/A | Stone et al. (1966) |
| Numerical Modifiers (Measure 1) | -0.031 | -0.333*** | 0.004 | N/A | Pennebaker et al. (2015) |
| Food References | -0.025 | -0.164*** | 0.003 | N/A | Author Developed |
| "For Me" Phrase | -0.025 | -0.024 | -0.043 | N/A | Yeomans et al. (2018) |
| Words >6 Letters | -0.024 | -0.225*** | -0.208*** | Y | Pennebaker et al. (2015) |
| Swearing | -0.019 | -0.063 | -0.078* | N/A | Yeomans et al. (2018) |
| Odor-Related Imagery | -0.015 | -0.062 | 0.070* | N/A | Martindale (1975) |
| Use of Determiners | -0.008 | -0.153*** | -0.163*** | Y | Author Developed |

*Note*. Regression coefficients are standardized (columns 3,4,6,7). * $p < .05$, ** $p < .01$, *** $p < .001$. The third column is produced by running a series of regressions (one for each feature) where condition (control or warmth) is the independent variable and the feature is the dependent variable. The fourth column is produced by running a series of regressions (one for each feature) where the judge warmth ratings are the independent variable and the feature is the dependent variable. Features in the repository but not in the table had zero coefficients in the lasso model, indicating that they were least predictive of warmth signaling. See OSF Repository for operationalizations of the features.

## Stage 3: Interpretation of Results

In Stage 2, we took an exploratory approach to understanding the utilization and effectiveness of competence and warmth signals in natural language. In Stage 3, we qualitatively assess these findings with the goal of better understanding the results, situating them in existing literature, and developing a set of testable hypotheses (see Table A1 in Appendix; see Supplementary Materials for additional details on how each feature was interpreted). In Stage 4, we quantitatively test a subset of these hypotheses on a new dataset.

### Competence Signaling

**Accurate Signals of Competence**. The majority of the features that predicted linguistic differences between the introductions in the competence signaling condition and the control condition were accurate competence signals, suggesting that individuals are adept at altering self-presentational language to appear more competent.

Individuals who attempted to strategically present themselves as competent (versus provided no impression management direction) increased work and achievement-related language, as well as their use of achievement markers (e.g., “I am a third generation artist”; “I have a bachelors degree in Business management and a minor in communications”). This mirrors prior findings connecting achievement at work to impressions of competence (Abele & Brack, 2013; Uchronski, 2008). People presenting themselves as competent also increased references to power, another signal previously associated with perceived competence (Fiske, Cuddy, Glick & Xu, 2002). As such, our first two hypotheses are that people emphasize their own achievements and successful pursuit of goals (Hypothesis C1) as well as references to their own power (Hypothesis C2) when attempting to signal competence.

We next found that participants increased the length of their sentences, used better grammar, and employed more complex and technical language when attempting to convey competence (Bloom, Miller & Hood, 1975). They also made fewer grammatical errors such as the use of run-on sentences (e.g., “Hi, am M_____, practically I love settings goals for myself to achieve or I might get carried away with distraction, I love when people always ask me to assist, even when busy…”). This suggests competence signaling is associated with showcasing one’s command of the English language (Hypothesis C3).

Stage 2 results also suggested that participants in the competence condition utilized less negation and fewer revision discourse markers compared to those in the control condition. Our qualitative analyses suggest two potential competence-signaling strategies. First, people reduced their discussions of the qualities, skills, or beliefs that do not describe them (e.g., “I'm not a showy patisserie chef”; “I don't have any children and I am not married”; Hypothesis C4). By refraining from discussions of what does not describe them, individuals might be trying to avoid reader assumptions that these anti-descriptors are due to their inabilities. Second, when signaling competence, people reduced their discussions of the discrepancies between the life that they currently have and the life that they want (e.g., “I hope to soon become a teacher but for now I work behind a desk”; Hypothesis C5). One potential explanation is that participants anticipate that highlighting discrepancies between their current state and their desires and ambitions could be attributed to their inability to reach their goals, which would reduce perceived competence.

Finally, participants signaling competence minimized discussion of their engagement and enjoyment in hedonic activities. These activities typically took the form of passive activities, such as watching television or movies and playing video games. Although not previously directly linked to competence signaling, an overindulgence in passive activities has been shown to be

associated with laziness (Linebarger, Chernin, Kotler, 2008), which itself is related to incompetence (Kervyn, Bergsieker, Grignard & Yzerbyt, 2016). Thus, we propose people decrease their discussion of passive activities when signaling competence (Hypothesis C6).

**Inaccurate Signals of Competence**. While individuals were generally skilled at adjusting their self-descriptions to appear more competent, we observed several systematic errors in competence impression management. First, we found that participants increased their use of clausal complements (e.g., "I am self-motivated and do not require oversight to complete my tasks in a timely and proficient manner"), filler discourse markers ("The on[e] thing though that does stand out about me is that I will do whatever I can to help others even at the expense of doing something for myself"), and certainty-related language when attempting to convey competence. On qualitative analysis, these features appear to capture instances where participants introspected and reflected on the stable aspects of their thoughts and actions (Hypothesis C7). Participants also counterproductively increased their use of integrity-related language (e.g., "I am courageous, principled, fair, responsible…"), suggesting that they attempt to signal competence by indicating that they are guided by beliefs and values (Hypothesis C8).

Our competence signaling model also identified that participants in the competence condition reduced their use of simple self-descriptions (e.g., "I am a 27 year old female"; Hypothesis C9) in favor of more complex, introspective statements about their character and traits. This was seen most clearly in hobby descriptions: while discussions of active hobbies were a positive indicator of competence (e.g., "My favorite hobbies are fishing..."), participants were less likely to discuss them when strategically signaling competence (Hypothesis C10).

Another unsuccessful competence strategy was the use of explicit declarations of one's positive traits, particularly those related to competence (e.g., "I see myself as a capable and

experienced person able to handle any task thrown my way"; Hypothesis C11). This reflects the self-promoter's paradox, a widely-theorized proposition with little prior empirical support, which suggests that because competent people do not need to explicitly proclaim or defend their competence, those that do engage in such promotion are viewed as less competent (Leary, 1995; Jones, 1989).

Finally, we also found that while participants in the competence condition reduced their lexical diversity in their introductions relative to those in the control condition (Hypothesis C12), competence perceptions were positively related to lexical diversity. This may be a result of the difference in focus between the introductions in control and competence conditions: while introductions in the control condition appeared more likely to supply an array of information about the writer, introductions in the competence condition tended to focus on a narrower set of topics, typically work-related discussions and reflections about the stable aspects of one's identity and character. While it has been previously proposed that increasing lexical diversity is a positive indicator of competence (e.g., Bradac, Konsky & Davis, 1976), the present research suggests that this strategy of managing competence impressions may be overlooked by individuals or deemed less important relative to other strategies, some of which may be counterproductive (i.e., expressing consistent character and explicitly declaring one's competence).

**Warmth Signaling**

**Accurate Signals of Warmth**. Despite occasionally struggling to accurately express competence, participants were better able to accurately express warmth. When people were explicitly told to present themselves as warm individuals (versus provided no impression management direction), they were more focused on others compared to themselves (Hypothesis

W1). Our warmth signaling model suggests that they reduced the focus on themselves in three distinct ways. First, participants avoided sentences that start with “I” or “my,” and used open clausal complements, where the subject of the clause (typically first person) is missing from the sentence (e.g., “I a[m] in mid late 30's and like to spend my time working at ou[r] local church. I enjoy working with younger kids and try my best to be a good role model. I work in the non profit field and like to give back to my local community”). The tendency to remove the focus on the self when expressing warmth reflects Bakan (1966)’s early delineation of agency (competence) and communion (warmth) as “I” and “not-I”. Second, mentioning others and discussing social relationships was an effective warmth signaling strategy, in line with previous research (e.g., Abele & Wojciazke, 2007; Hypothesis W2). Finally, when signaling warmth, participants reduced the focus on themselves by trying to establish a connection with the reader (Hypothesis W3), typically through the use of second person pronouns (e.g., “I hope if you are reading this you are not impacted negatively from Covid”) and by asking questions (e.g., “Can you tell me a little bit about yourself?  What makes you tic?"). Connecting with the reader to signal warmth aligns with research suggesting that question-asking can increase interpersonal liking (Huang, Yeomans, Brooks, Minson & Gino, 2017).

Another warmth signaling strategy was the expression of positive emotions, particularly happiness and excitement (Hypothesis W4). This approach is corroborated by a large body of research suggesting that these emotions signal an intent to build social bonds and facilitate the development of strong relationships (Keltner & Haidt, 1999; Van Kleef, 2009).

Participants in the warmth condition seemed to anticipate that their introductions had to suggest that they put a lot of effort into them, so they used more varied sentence structures (Hypothesis W5) and greater lexical diversity (Hypothesis W6) in their introductions compared

to those in the control condition. There were also less likely to resort to low-effort ways of describing themselves like sharing a list of hobbies they enjoy, or presenting a series of impersonal facts such as their age, location, or degree (Hypothesis W7). Previous research suggests that when an individual does not put effort into an interaction or focus on trivial, uninteresting topics, their counterparts are more likely to experience interpersonal boredom, which leads them to dislike the target individual (Leary, Rogers, Canfield, & Coe, 1986). Our results suggest that individuals are aware that they have to prevent their counterparts' interpersonal boredom in order to appear warm.

Interestingly, while language related to introspection and character stability was an inaccurate competence signaling strategy, likely because it can be perceived as disingenuous, the use of these strategies to signal warmth was effective (e.g., "I am also someone who is empathetic and caring to everyone around me"; Hypothesis W8). In other words, when individuals used introspection and character stability to generate a narrative about their competence, their strategy often backfired, but when individuals used introspection and character stability to generate a narrative about their warmth, their strategy generally succeeded.

One way that participants asserted character stability to strategically signal warmth is by suggesting that they are guided by beliefs and values (e.g., "I am always honest about anything I do"; Hypothesis W9). By providing a framework for the way that participants typically interact with others, discussions of values and beliefs may increase perceived integrity, a component of warmth (Fiske, Cuddy & Glick, 2007).

**Inaccurate Signals of Warmth**. The only inaccurate signal of warmth identified by our model was the reduced use of female references (e.g., mother, sister). While references to women was a positive indicator of warmth perceptions, participants were less likely to discuss

their relationships with women when explicitly told to present themselves as warm individuals (versus provided no impression management direction; Hypothesis W10).

**Competence and Warmth Tradeoffs**

Trade-offs between competence and warmth have been well-documented in both the impression formation and the impression management literatures (e.g., Holoien & Fiske, 2013; Judd, James-Hawkins, Yzerbyt & Kashima, 2005). People tend to believe that targets who are high on either competence or warmth will be lower on the other dimension (Kervyn, Bergsieker, Grignard & Yzerbyt, 2016). Similarly, when people are trying to convey impressions of either warmth or competence, they often downplay one in order to express the other (Holoien & Fiske, 2013; Swencionis, Dupree, & Fiske, 2017).

We find further evidence for this warmth competence tradeoff in our analyses. Individuals who were explicitly told to express competence were less likely to use words associated with warmth (Hypothesis C13), emotion (Hypothesis C14), or social relationships (Hypothesis C15), compared to those who were not provided with any impression management direction. They were also more likely to be focused on themselves rather than others (Hypothesis C16).

A similar trade-off existed between competence and warmth in warmth signaling; specifically, the use of work-related language (Hypothesis W11) and indications of their command of the English Language (such as longer words; Hypothesis W12) were lower in the warmth condition relative to the control condition, suggesting that individuals were downplaying their competence in order to convey greater warmth.

In Stage 4, we test a subset of the hypotheses developed in Stage 3 using a new dataset to confirm that the competence and warmth signaling strategies identified in this study are indeed

ways that participants signal competence and warmth. In Stage 4, we focus on testing hypotheses that could be easily assessed through human judgement (e.g., mentions of social relationships), rather than hypotheses that are better assessed through algorithmic judgement (e.g., language complexity). In this stage move beyond the specific, simplified text features examined in Stage 2 to instead evaluate more expansive psychological constructs (e.g., power expression, stability of character).

## Stage 4: Confirmatory Test of Competence and Warmth Signals

In Stage 3, we outlined 16 competence hypotheses and 12 warmth hypotheses derived from the analyses performed in Stage 2. Some of these hypotheses are based on actual differences in language use and structure (e.g., Hypotheses C12, W5, W6), which are best assessed by a machine learning approach such as that used in Stage 2. However, other hypotheses (e.g., being guided by one's beliefs and values) represent more sophisticated psychological processes that are better assessed by human beings. In Stage 4, we selected thirteen hypotheses (seven competence and six warmth signaling hypotheses) of the latter type to test using evaluations from human coders (see Table A1 in Appendix). A portion of these hypotheses are novel in that they have not been associated with perceptions or expressions of competence and warmth in past literature; other hypotheses have been proposed in previous work and were included to validate previous findings (and, in part, to validate our method of analysis).

To test these hypotheses, we collected a new dataset of introductions and asked independent judges to evaluate them for the existence of the hypothesized signals. This study was also pre-registered (https://osf.io/nr9ta/?view_only=320f981e2efc49e08ae026a57b0a37d6).

### Method

***Participants***

**Text Writers**. To create the introductions dataset, we recruited 1,201 participants located in the United States through Prolific Academic to complete an eight-minute survey for $1.60[7]. We used G*Power to calculate the sample size required to detect small-sized effects (Cohen's *d* = 0.2) in our study based on 80% power (Faul, Erdfelder, Lang & Buchner, 2007). As pre-registered, we excluded 8 participants whose writing was copied from the internet, which left us with 1,193 participants ($M_{age}$ = 37.4 years; $SD_{age}$ = 13.1; Table 1 presents the gender and race breakdowns for these participants).

**Text Evaluators.** To evaluate the introductions, we recruited another 1,201 participants located in the United States to complete a ten-minute survey for $2.00. As pre-registered, three participants were excluded because they did not complete the survey because they failed the English language comprehension check at the beginning of the study, two were excluded because they did not receive introductions to evaluate during the study due to technical difficulties, and three were excluded because the introductions they received were already evaluated by other participants, leaving 1,193 participants ($M_{age}$ = 38.4 years; $SD_{age}$ = 13.4; Table 1 presents the gender and race breakdowns for these participants).

***Design***

**Text Writers**. Our introductions collection process in this stage mirrored that of Stage 2.

**Text Evaluators.** After consenting to take part in the study, evaluators were asked to respond to the same English language comprehension check question used in Stage 2. Again, evaluators could not complete the survey if they failed the comprehension check. If they

[7] We requested 1,200 participants on Prolific, as reported in our pre-registration, but we ended up with 1,201 participants.

answered the comprehension check successfully, there were randomly assigned to evaluate six of the 1,193 introductions. Evaluators were asked to read and evaluate one introduction at a time.

After reading the introduction, evaluators responded to the following question: "What stands out to you most about this Prolific worker? Please use your own words." This question was meant to ensure evaluators were spending enough time with the introduction before they evaluated the introductions. Participants were then asked to evaluate each introduction using ten questions (see Table A2 in Appendix for items and ICCs). At the end of the survey, evaluators reported their gender, age, and race.

**Results**

We tested the seven competence signaling hypotheses by comparing the introductions in the competence condition with those in the control condition, and we tested the six warmth signaling hypotheses by comparing the introductions in the warmth condition with those in the warmth condition. Results of the analyses are displayed in Table 4.

**Table 4**

*Stage 3 Results*

| | Hypothesis | Predicted Direction | β |
|---|---|---|---|
| | | ***Competence Signaling Hypotheses*** | |
| C1 | Goal Pursuit | Positive (+) | 0.37*** |
| C2 | Expressing Power | Positive (+) | 0.25*** |
| C7 | Character Stability in Actions | Positive (+) | 0.12** |
| | Character Stability in Thoughts | | 0.10** |
| C8 | Importance of Beliefs and Values | Positive (+) | 0.05 |
| C10 | Focus on Hobbies | Negative (-) | -0.57*** |
| C15 | Focus on Relationships | Negative (-) | -0.07* |
| C16 | Self-Focus | Positive (+) | 0.04 |

| | | | |
|---|---|---|---|
| | | ***Warmth Signaling Hypotheses*** | |
| W1 | Other-Focus | Positive (+) | 0.43*** |
| W2 | Focus on Relationships | Positive (+) | 0.37*** |
| W4 | Express Positive Emotions | Positive (+) | 0.31*** |
| W8 | Character Stability in Actions | Positive (+) | 0.25*** |
| | Character Stability in Thoughts | | 0.23*** |
| W9 | Importance of Beliefs and Values | Positive (+) | 0.34*** |
| W10 | Focus on Relationships with Women | Negative (-) | 0.19*** |

*Note:* Regression coefficients are standardized. * $p < .05$, ** $p < .01$, *** $p < .001$. The coefficients are produced by running a series of regressions where condition (control or [competence/warmth]) is the independent variable and the evaluations are the dependent variable.

In all, five of the warmth hypotheses and five of the competence hypotheses were supported. Participants signaled competence by discussing their work, achievement and goal pursuit (Hypothesis C1), expressing the power they hold (Hypothesis C2), and expressing that their thoughts and actions are stable (Hypothesis C7). They also reduced discussions of social relationships (Hypothesis C15) and hobbies (Hypothesis C10). We found no support that participants signaled competence by increasing discussions on their beliefs and values (Hypothesis C8) or focusing more on themselves compared to others (Hypothesis C16).

Participants signaled warmth by being more focused on others compared to themselves (Hypothesis W1), discussing their social relationships (Hypothesis W2), expressing positive emotions (Hypothesis W4), expressing that their thoughts and actions are stable (Hypothesis W8), and sharing their beliefs and values (Hypothesis W9). We do not find support for our hypothesis that participants will be less likely to discuss their relationships with women in the warmth condition compared to the control condition (Hypothesis W10). Interestingly, we find

the opposite effect where, in this dataset, participants appear more likely to discuss their relationships with women in the warmth condition compared to the control condition.

Although not pre-registered, we also examined the extent to which differences between conditions ([competence/warmth] versus control) could be predicted by the NLP features of the [competence/warmth] signaling models from Stage 2 (see Tables A3 and A4 in Appendix).

**Discussion**

In a confirmatory follow-up study using a new dataset, we tested a series of hypotheses produced by the exploratory models developed in Stage 2. Some of these hypotheses were novel while others validated previous findings. Despite the fact that inter-rater reliability was not high for some of our items—a potential limitation of our work—we still found support for all but three of the thirteen hypotheses we examined. This strongly suggests that the hypotheses generated in Stage 2 represented true differences in the way people attempted to strategically signal competence and warmth to others.

## General Discussion

Our research takes a combined exploratory and confirmatory approach to investigate how individuals strategically signal competence and warmth in self-presentation, utilizing a mix of quantitative and qualitative methods reminiscent of well-established approaches in related fields, such as grounded theory (e.g., Charmaz, 2014) and process tracing (e.g., Beach, 2017). Although exploratory research has been traditionally undervalued in social psychology (Rozin, 2001), our research follows other influential descriptive work (e.g., Fiske, Cuddy, Glick & Xu, 2002; Weiss et al., 2021) with the goal of laying groundwork for future research to build off of. We begin this process of validating and interpreting some of the initial findings by additionally deriving and testing a series of hypothesis using a more standard hypothetico-deductive approach.

The present work consisted of four stages. In Stage 1, we built a repository of over seven hundred NLP features that assessed both text content and structure. Then, we used these features in Stage 2 to create machine-learning models that explored how individuals signal competence and warmth in natural language. We also examined the extent to which these signals were accurate or inaccurate predictors of competence and warmth predictions. Based on these analyses, we formulated hypotheses about how individuals strategically present themselves as competent and warm in Stage 3. In Stage 4, we narrowed our focus to a subset of the hypotheses presented in Stage 3, testing them on a new dataset using assessments of independent human judges. Our analyses produced novel insights about how individuals strategically present themselves as competent or warm, as well as validated existing findings that were previously derived using different methods.

**Novel Insights**

Across an exploratory and a confirmatory study, we find that individuals are more likely to express a consistent and stable character when strategically signaling both competence and warmth. Participants used language associated with introspection and self-reflection to discuss the stable aspects of their identity and character. Stage 2 analyses suggest that while this strategy successfully conveys warmth, it is a counterproductive strategy for signaling competence. Differences in reactions to competence-related versus warmth-related transgressions may provide a possible explanation for this pattern of results. Highly competent individuals are expected to show different levels of competence across different situations, and any competence-based mistakes in one situation typically does not dramatically influence overall perceptions of their competence (Skowronski & Carlston, 1987; Mende-Siedlecki, Baron, & Todorov, 2013). However, high-warmth individuals are expected to show increased warmth consistently across

all situations, and any warmth-based violation in one instance can strongly influence overall perceptions of warmth (Kim, Dirks, Cooper & Ferrin, 2006). Accordingly, narratives that use introspection to craft a stable narrative about a person's competence may be less believable because it is less likely that an individual follows the same pattern of behaviors across all situations. On the other hand, stable narratives about a person's warmth may appear more believable because it is expected that a person's warmth related characteristics (e.g., trustworthiness, kindness) are stable across different circumstances.

Both exploratory and confirmatory investigations also suggest that individuals are less likely to discuss their hobbies when they are strategically signaling competence. However, Stage 2 analyses suggest that this is a counterproductive competence strategy: while individuals reduce their discussions of hobbies when signaling competence, discussions of hobbies, particularly active hobbies, are positively associated with competence. The reduction of hobby discussions may represent the general tendency to reduce the use of self-descriptions when signaling competence, in favor of more complex and introspective statements. While participants in the control conditions of both Stage 2 and 3 appear to focus on sharing simple facts about themselves, such as their demographics, hobbies, and likes and dislikes, participants in the competence condition focus their introductions more on providing a stable narrative about their character and approach to life. Future research should examine whether this effect is driven primarily by the presence of the more complex, introspective statements detailed above or by the absence of simple self-descriptions, including hobby discussions.

**Validation of Existing Findings**

In addition to introducing novel hypotheses about how individuals manage impressions of competence and warmth, our research also sought to validate existing findings using a novel

methodology. Across both exploratory and confirmatory analyses, we found that individuals signal competence by expressing the power they hold (e.g., Fiske, Cuddy, Glick & Xu, 2002), and discussing their work, achievement, and goal pursuit (e.g., Abele & Brack, 2013; Uchronski, 2008). Individuals signal warmth by suggesting that they are guided by beliefs and values (e.g., Fiske, Cuddy & Glick, 2007), expressing positive emotions (e.g., Keltner & Haidt, 1999; Van Kleef, 2009), and by focusing more on others compared to themselves (e.g., Bakan, 1966).

Our research also provides additional evidence for the well-documented trade-off between competence and warmth in impression management (e.g., Holoien & Fiske, 2013; Judd, James-Hawkins, Yzerbyt & Kashima, 2005). Across both exploratory and confirmatory investigations, we found that competence signaling was associated with a reduction in the discussion of social relationships while warmth signaling was associated with an increase in relationship discussions. Linguistic analyses in Stage 2 also revealed that while competence signaling was associated with the increased use of complex language, warmth signaling was associated with a decrease in its use (these analyses were not pre-registered in Stage 3; See Tables A3 and A4 in Appendix).

## Contributions

### *Theoretical Implications*

By linking data from communicators and perceivers, we were able to assess the efficacy of various competence and warmth signaling strategies. Our research demonstrates that people are decently capable at managing impressions: most of the strategies used to signal competence and warmth were accurate. However, there appear to be systematic mismanagements, particularly in competence impressions. Future research should explore whether our findings

hold in higher stakes environments, such as hiring or politics, and whether certain segments of the population are more likely to make critical impression management error than others.

Beyond simply uncovering new counterproductive signaling strategies, our work also proposes two theoretical propositions about impression mismanagement. First, we propose that individuals are more likely to make errors when strategically signaling competence versus warmth. A broad comparison of people's relative proficiency in warmth versus competence signaling was only possible because of the bottom-up approach taken in this paper. In fact, a cursory review of the counterproductive self-presentational strategies identified in the existing literature (e.g., humble-bragging, pairing self-depreciation with bragging, highlighting one's talents over efforts, hiding one's mistakes or one's successes) confirms they are indeed typically related more to managing impressions of competence than warmth (Brooks, Huang, Abi-Esber, Buell, Huang & Hall, 2019; John, Barasz & Norton, 2016; O'Donnell, Jung & Critcher, 2016; Savitsky, Eply & Gilovich, 2001; Sekhon, Bickart, Trudel & Fournier, 2015; Sezer, 2021; Sezer, Gino & Norton, 2018; Steinmetz, 2018). We theorize that the increased rate of errors in competence signaling relative to warmth signaling may be due to the contextualized nature of competence: while determiners of warmth perceptions may be fairly consistent across situations, determiners of competence impressions may be context-dependent, making them more difficult to manage.

Second, we offer a proposition for why individuals systematically employ counterproductive strategies to express competence. By utilizing parallel methodologies to explore both competence and warmth impression management in tandem, we find that most of the counterproductive competence strategies appear to be productive warmth strategies. The precedence of warmth over competence in interpersonal interactions has been well-documented.

For example, individuals form warmth judgements more quickly than competence judgements (e.g., Ybarra, Chan, & Park, 2001). As such, , we posit that individuals may overgeneralize warmth-enhancing strategies and erroneously attempt to use them to express competence as well.

### *Practical Implications*

Written attempts at self-presentation are prevalent across a variety of contexts, including dating (e.g., Tinder), freelancing (e.g., Fiverr), healthcare (e.g., doctor bios on health provider websites), babysitting (e.g., Sittercity), and tutoring (e.g., Wyzant). The present research highlights a number of practical strategies individuals can use to tailor their presentation of themselves to others. Additionally, while previous work suggests strategies individuals should use or avoid in general when managing impressions (e.g., Steinmetz, Sezer, & Sedikides, 2017), the current research highlights the importance of the specific self-presentational goal one wants to achieve when determining a strategy's efficacy. For example, in contexts where warmth perceptions are more important (e.g., babysitting), asserting character stability may be effective, while in contexts where competence perceptions are more important (e.g., tutoring), this same strategy may fall short. Accordingly, advice on impression management should focus on what type of strategies are best for managing given impressions, rather than outlining productive versus counterproductive strategies more generally.

### *Methodological Implications*

Psychological researchers have—with a few notable exceptions (e.g., Pennebaker, Boyd, Jordan & Blackburn, 2015)—traditionally been hesitant to adopt linguistic analytical methods because of the lack of standards and tools available. We contribute to a nascent but growing literature using natural language processing to provide analysis of important psychological constructs within text data (Berger & Packard, 2021; Jeong, Minson, Yeomans & Gino, 2019;

Ordenes, Ludwig, De Ruyter, Grewal & Wetzels, 2017; Packard & Berger, 2021; Yeomans, Kantor, & Tingley, 2018; Yeomans, Minson, Collins, Chen, & Gino, 2020).

Furthermore, our approach to psycholinguistics is unique in two main ways. First, our methodology allows for the consideration of language structure rather than just focusing on the words used, as most explanatory models in the social sciences currently do (e.g., Decter-Frain & Frimer, 2016; Dupree & Fiske, 2019; Pietraszkiewicz et al, 2018; Nicolas, Bai & Fiske, 2022). While more complex, deep learning models used to optimize prediction (e.g., Biel, Aran & Gatica-Perez, 2011; Biel & Gatica-Perez, 2012; Pang & Ring, 2020) do take structure into consideration (Tenney, Das & Pavlick, 2019), the inability to understand how these models make their predictions limits their use in theory development. Our work highlights how explanatory machine-learning models can take language structure into consideration while still enabling theory-building.

Second, many of our features are not pre-defined, strengthening the exploratory nature of our work. Traditionally, features have been built to operationalize a given construct (e.g., negative emotion, social processes, past focus). However, our feature set includes features that assess grammatical constructions that have not been previously linked to superordinate constructs or ideas. These structural features allowed us to capture the use of strategies such as introspection and run-on sentences, which we would not have known to define prior to our study.

Accordingly, our approach uniquely uses machine-learning to guide qualitative exploration of text data, rather than purely as a predictive tool, responding to calls for more descriptive research in social psychology (Rozin, 2001) and to calls for the integration of both explanatory and predictive modeling in the social sciences (Hofman et al., 2021). This descriptive process not only allows for the independent replication of previous findings that were

ascertained using different methodologies, but also the generation of novel insights that can move beyond and complement existing theory (cf. Sheetal, Chaudhury & Savani, 2022; Sheetal, Feng & Savani, 2020). For example, our work provides some of the first empirical support for the previously-theorized self-promoter's paradox (Leary, 1995).

**Limitations & Future Directions**

Our study had several limitations that present opportunities for future research. First, our datasets were collected through lab studies. While an artificial lab context can help build an understanding of impression management in a controlled environment, the extent to which we can generalize our results is limited. Future research should explore whether our findings are reflected in more real-world contexts such as hiring or dating. These contexts can also provide behavioral outcomes which can help illuminate potential downstream consequences of different competence and warmth signaling strategies.

Second, the self-descriptions used in this study were written rather than spoken. As a result, it remains unclear whether people utilize the same competence and warmth signaling strategies in oral communication that they do in written text (cf. Schroeder & Epley, 2015). Similarly, we might observe different patterns of results when impression management is occurring in a synchronous conversation (e.g., Godfrey, Jones, & Lord, 1986). Future research should explore the extent to which communication method affects the utilization and efficacy of competence and warmth signaling strategies.

Third, unless participants chose to disclose social identity markers in their introduction, the independent judges evaluating their competence and warmth did not know any demographic information. Research suggests that social identities and demographic characteristics play a large role in how different impression management strategies are used (e.g., Dupree, 2021; Garr-

Schultz & Gardner, 2018) and perceived (e.g., Martin, North, & Fiske, 2018; North & Fiske, 2013; Roberts, 2005). Accordingly, the efficacy of, and decision to use, different strategies may depend on whether or not the perceiver has insight into the social identity of the communicator. Communicators may also adjust their impression management strategies depending on whether or not they believe their counterpart has information about their social identity. Similarly, perceiver judgements of these impressions may also depend on their identities. Further research should explore the extent to which the communicator and perceiver identity affect how competence and warmth impressions are signaled and perceived.

Relatedly, while machine learning and natural language processing are useful methodologies to help simplify extremely large or complex data, it is important to highlight that the results they produce are contingent on how the models are trained. For example, the ratings used in Stage 2 of the process came from a sample of online participants who were not representative of the broader population on characteristics such as age, race, and socioeconomic status. As a result, the findings regarding what are and are not accurate signals of competence and warmth likely reflect the beliefs of the particular evaluators used in these studies. It is important that future research takes this into account and systematically explores when, and for whom, these various signals play a role in impression management.

Finally, this study was run in English using a U.S.-based sample. While previous work has demonstrated the generalizability of competence and warmth as fundamental dimensions of social cognition across many countries (Fiske, 2018; Judd et al, 2005), this does not mean that people from all cultural backgrounds signal them in the same way. For example, previous work has found differences in the use of personal pronouns among countries higher versus lower on individualism (Kashima & Kashima, 1998). This suggests the use of personal pronouns may be

interpreted differently depending on where they are used. Future work should explore the role of cultural differences in signaling competence and warmth to others.

## Conclusion

Our research takes a bottom-up approach to understanding the utilization and effectiveness of competence and warmth signals in self-presentational language. To do so, we built a repository of over seven hundred natural language processing features and used machine-learning models to determine which features are most predictive of competence and warmth signaling. Then, we evaluated whether the signals used to convey competence and warmth actually led to higher competence and warmth perceptions among observers. Finally, we examined a subset of the competence and warmth signaling strategies using human raters to deductively test the findings proposed by the machine learning models.

We find that individuals are overall proficient at strategically altering their language to signal competence and warmth in self-presentational language. Yet they also make systematic errors, particularly when trying to signal competence. It appears that many systematic mis-managements of competence impressions are due to the overgeneralization of warmth-enhancing strategies. In all, we propose that a combined exploratory-confirmatory approach to exploring psychological processes can be used to re-examine existing research findings and illuminate new phenomena.

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# Appendix

## Table A1

*Stage 3 Hypotheses*

| | Hypothesis | Tested in Stage 4 |
|---|---|---|
| | ***Competence Signaling Hypotheses*** | |
| | *When strategically signaling competence, participants will be:* | |
| C1 | More likely to discuss work, achievement, and goal pursuit. | X |
| C2 | More likely to discuss the power they hold. | X |
| C3 | More likely to showcase their command of the English language. | |
| C4 | Less likely to discuss the qualities, skills, or beliefs that do not describe them. | |
| C5 | Less likely to discuss the discrepancies between their current and desired life. | |
| C6 | Less likely to discuss their engagement in passive activities. | |
| C7 | More likely to express a consistent and stable character. | X |
| C8 | More likely to suggest that beliefs and values guide them. | X |
| C9 | Less likely to use simple self-descriptions. | |
| C10 | Less likely to discuss their hobbies. | X |
| C11 | More likely to explicitly declare their positive traits. | |
| C12 | Less likely to use lexically diverse language. | |
| C13 | Less likely to use warmth-associated language. | |
| C14 | Less likely to express emotion. | |
| C15 | Less likely to discuss their relationships. | X |
| C16 | More focused on themselves than on others. | X |
| | ***Warmth Signaling Hypotheses*** | |
| | *When strategically signaling warmth, participants will be:* | |
| W1 | More focused on others than on themselves. | X |
| W2 | More likely to discuss their relationships. | X |
| W3 | More likely to try to establish a connection with the reader. | |
| W4 | More likely to express positive emotion. | X |
| W5 | More likely to use varied sentence structures. | |
| W6 | More likely to use lexically diverse language. | |
| W7 | More likely to express effort. | |
| W8 | More likely to express a consistent and stable character. | X |
| W9 | More likely to suggest that beliefs and values guide them. | X |
| W10 | Less likely to discuss their relationships with women. | X |
| W11 | Less likely to use work-related language. | |
| W12 | Less likely to showcase their command of the English language. | |

**Table A2**

*Stage 4 Evaluation Collection Items*

| Hypotheses | Item | ICC |
|---|---|---|
| C1 | To what extent are work, achievement, and goal pursuit important to this Prolific worker? | 0.69 |
| C2 | How much power does this Prolific worker hold? Power is defined as the ability to direct or influence the behavior of others or the course of events. The more the Prolific worker can influence the behavior and outcomes of others, the more power they hold. | 0.57 |
| C7 & W8 | (1) How consistent are this Prolific worker's actions? Their actions are consistent if they will act the same across a wide range of different situations. | 0.40 |
| | (2) How consistent are this Prolific worker's thoughts? Their thoughts are consistent if they will think the same across a wide range of different situations. | 0.35 |
| C8 & W9 | To what extent do this Prolific worker's beliefs and values guide them? In other words, to what extent do you believe this Prolific worker's actions are determined by their beliefs and values? | 0.56 |
| C10 | To what extent are hobbies important to this Prolific worker? | 0.81 |
| C15 & W10 | To what extent are social relationships important to this Prolific worker? | 0.75 |
| C16 & W1 | To what extent is this Prolific worker focused on themselves (-3) or focused on others (3)? | 0.79 |
| W4 | How would you describe the emotional tone of this introduction from extremely negative (-3) to extremely positive (3)? | 0.67 |
| W10 | To what extent are women important to this Prolific worker? | 0.59 |

*Note:* All questions were answered on a 5-point scale (1 = "Not at all" to 5 = "A great deal"), except for two questions associated with hypotheses C16, W1, and W4 which were answered on a 7-point scale (-3 = ["Extremely focused on themselves"/ "Extremely negative"] to 3 ["Extremely focused on others"/ "Extremely positive"].

**Table A3**

*Competence Signaling in Stages 2 and 4*

| Feature | **Stage 2** Participant Condition (Control - Competence) | **Stage 2** Accurate Competence Signal (Y/N) | **Stage 4** Participant Condition (Control - Competence) | Source |
|---|---|---|---|---|
| ***Features Positively Related to Competence Condition*** | | | | |
| Achievement-Related Language | 0.337*** | Y | 0.326*** | Pennebaker et al. (2015) |
| Work-Related Language | 0.341*** | Y | 0.379*** | Pennebaker et al. (2015) |
| Power References (Measure 1) | 0.238*** | N/A | 0.251*** | Pennebaker et al. (2015) |
| Achievement Identity Markers | 0.174*** | Y | 0.109*** | Author Developed |
| Readability Index (Measure 1) | 0.271*** | Y | 0.185** | Rinker (2020) |
| Acknowledgement | 0.136*** | N/A | 0.009 | Yeomans et al. (2018) |
| Average Sentiment | 0.194*** | N/A | 0.093** | Rinker (2019) |
| "I" Focus | 0.125** | Y | 0.083* | Author Developed |
| Decreased Use of Superlative Adjectives | 0.236*** | N/A | 0.106** | Author Developed |
| Lexical Uniformity | 0.081* | N | -0.014 | Benoit et al. (2018) |
| Clausal Complements | 0.177*** | N | 0.084* | Author Developed |
| Certainty-Related Language | 0.171*** | N | 0.130** | Pennebaker et al. (2015) |
| Age of Acquisition | 0.265*** | Y | 0.204*** | Kuperman et al. (2012) |
| Readability Index (Measure 2) | 0.255*** | Y | 0.191*** | Rinker (2020) |
| Complex Sentences | 0.192*** | Y | 0.138*** | Author Developed |
| Competent Verbs & Adjectives | 0.267*** | N/A | 0.236*** | Author Developed |
| Conscientious Words | 0.188*** | N/A | 0.153*** | Payne et al. (2011) |
| Integrity Words | 0.101* | N | 0.102** | Payne et al. (2011) |
| Insight-Related Language | 0.238*** | N/A | 0.235*** | Pennebaker et al. (2015) |
| Causation-Related Language | 0.199*** | N/A | 0.149*** | Pennebaker et al. (2015) |
| Negative Sentiment | 0.095 | N/A | 0.069 | Jockers (2017); Hu & Liu (2004) |

| | | | | |
|---|---|---|---|---|
| Touch Imagery | 0.105* | N/A | -0.016 | Martindale (1975) |
| Declarations about One's Positive Traits | 0.178*** | N | 0.105** | Author Developed |
| Explicit Declarations of Competence | 0.160*** | N | 0.159*** | Payne et al. (2011) |
| Filler Discourse Markers | 0.176*** | N | 0.049 | Author Developed |
| Power References (Measure 2) | 0.172*** | Y | 0.222*** | Stone et al. (1966) |
| Semicolons | 0.053 | N/A | -0.039 | Pennebaker et al. (2015) |
| Existential "There" | -0.063 | N/A | 0.062 | Author Developed |
| ***Features Negatively Related to Competence Condition*** | | | | |
| Punctuation Use | -0.251*** | N/A | -0.190*** | Pennebaker et al. (2015) |
| Warm Verbs & Adjectives | -0.154*** | Y | -0.086** | Author Developed |
| Social Relationship References | -0.204*** | Y | -0.098** | Pennebaker et al. (2015) |
| Food References | -0.250*** | N/A | -0.279*** | Pennebaker et al. (2015) |
| Leisure References | -0.270*** | N/A | -0.342*** | Pennebaker et al. (2015) |
| Television & Video Games References | -0.210*** | Y | -0.212** | Pennebaker et al. (2015) |
| Simple Self-Descriptions | -0.196*** | N | -0.117*** | Author Developed |
| Proper Nouns | -0.246*** | N/A | -0.174*** | Author Developed |
| Noun Phrase as Adverbial Modifier | -0.167*** | N/A | -0.097** | Author Developed |
| Negation (Measure 1) | -0.107** | Y | -0.022 | Author Developed |
| Run-on Sentences | -0.102* | Y | -0.108** | Author Developed |
| Revision Discourse Markers | -0.107** | Y | -0.116*** | Alemany (2005) |
| Hobby Words | -0.241*** | N | -0.198*** | Author Developed |
| Anxiety-Related Language | -0.101* | Y | 0.055 | Pennebaker et al. (2015) |
| Cold Imagery | -0.141*** | N/A | -0.101** | Martindale (1975) |
| Passive Auxiliary Verbs | -0.087* | N/A | 0.04 | Author Developed |
| Motion References | -0.148*** | N/A | -0.075* | Pennebaker et al. (2015) |
| Object Predicate | -0.100* | N/A | -0.052 | Author Developed |
| Joy | -0.200*** | Y | -0.114*** | Rinker (2019) |
| Expletives | -0.063 | N/A | 0.065* | Author Developed |
| References to the Unknown | -0.072 | N/A | -0.01 | Martindale (1975) |

| | | | | |
|---|---|---|---|---|
| Number of Sentences (Measure 1) | -0.166*** | N/A | -0.042 | Rinker (2020) |
| Male References | -0.143*** | N/A | -0.119*** | Pennebaker et al. (2015) |
| Number of Sentences (Measure 2) | -0.166*** | N/A | -0.042 | Rinker (2020) |
| Adverbs After Main Subject | -0.170*** | N/A | -0.044 | Author Developed |
| Negation (Measure 2) | -0.101* | Y | -0.019 | Rinker (2013) |
| Affect | -0.113** | Y | -0.072* | Pennebaker et al. (2015) |
| Number of Sentences (Measure 3) | -0.173*** | Y | -0.072* | Author Developed |

*Note*. Regression coefficients are standardized (columns 2 and 4). * $p < .05$, ** $p < .01$, *** $p < .001$. The second and third column is produced by running a series of regressions (one for each feature) where condition (control or competence) is the independent variable and the feature is the dependent variable. Features in the repository but not in the table had zero coefficients in the lasso model, indicating that they were least predictive of competence signaling. See OSF Repository for operationalizations of the features.

**Table A4**

*Warmth Signaling in Stages 2 and 4*

| Feature | Stage 2 Participant Condition (Control -Warmth) | Stage 2 Accurate Warmth Signal (Y/N) | Stage 4 Participant Condition (Control - Warmth) | Source |
|---|---|---|---|---|
| ***Features Positively Related to Warmth Condition*** | | | | |
| Exclamation Marks | 0.267*** | Y | 0.273*** | Pennebaker et al. (2015) |
| Social Relationship References | 0.383*** | Y | 0.339*** | Pennebaker et al. (2015) |
| Open Clausal Complements | 0.283*** | Y | 0.118*** | Author Developed |
| Community-Related Language | 0.241*** | N/A | 0.052 | Pencle & Malaescu (2016) |
| Introspection (Measure 1) | 0.153*** | Y | 0.080* | Author Developed |
| Positive Emotion | 0.340*** | Y | 0.266*** | Pennebaker et al. (2015) |
| Friendship-Related Language | 0.222*** | Y | 0.166*** | Pennebaker et al. (2015) |
| Filler Discourse Markers | 0.257*** | N/A | 0.039 | Author Developed |
| Certainty-Related Language | 0.282*** | N/A | 0.017 | Pennebaker et al. (2015) |
| Average Sentence Sentiment | 0.291*** | N/A | 0.06 | Rinker (2020) |
| Submission-Related Words | 0.198*** | N/A | 0.042 | Stone et al. (1966) |
| Clausal Complements | 0.315*** | N/A | 0.038 | Author Developed |
| Introspection (Measure 2) | 0.326*** | Y | 0.079* | Author Developed |
| Mental Verbs | 0.264*** | Y | 0.129*** | Author Developed |
| Relative Pronouns | 0.261*** | Y | 0.070* | Pennebaker et al. (2015) |
| Sentiment | 0.270*** | Y | 0.083* | Rinker (2019) |
| Third Person Plural Pronouns | 0.288*** | Y | 0.137*** | Pennebaker et al. (2015) |
| Psychological Drives | 0.222*** | Y | 0.089** | Pennebaker et al. (2015) |
| First Person Pronoun as Object | 0.219*** | N/A | 0.057 | Author Developed |
| Third Person Singular Present Verbs | 0.103* | Y | 0.141*** | Author Developed |
| Chaos-Related Imagery | 0.086* | N/A | 0.012 | Martindale (1975) |

| | | | | |
|---|---|---|---|---|
| Power References | <0.001 | N/A | -0.144*** | Pennebaker et al. (2015) |
| Amplification Words | 0.161*** | N/A | >-0.001 | Rinker (2013) |
| Round Brackets | 0.027 | N/A | 0.047 | Author Developed |
| Adverbial Clause Modifier | 0.244*** | N/A | 0.063 | Author Developed |
| Question Marks | 0.136*** | Y | 0.067* | Pennebaker et al. (2015) |
| Happiness | 0.421*** | Y | 0.173*** | Dodds et al. (2011) |
| Giving Agency | 0.095* | N/A | -0.06 | Yeomans et al. (2018) |
| Infinitive “To” | 0.158*** | Y | 0.077* | Author Developed |
| Lexical Diversity | 0.148*** | Y | 0.208*** | Rinker (2020) |
| Touch Imagery | 0.096* | N/A | 0.009 | Martindale (1975) |
| Second Person Pronouns | 0.233*** | Y | 0.087** | Author Developed |
| Personal Pronouns Before Main Subject | 0.214*** | N/A | 0.065 | Author Developed |
| Use of "You" or "We" | 0.185*** | Y | 0.132*** | Author Developed |
| Acknowledgement | 0.132** | N/A | 0.013 | Yeomans et al. (2018) |
| Quotation Marks | 0.076 | N/A | 0.032 | Pennebaker et al. (2015) |
| Agent | 0.051 | N/A | 0.001 | Author Developed |
| Impersonal Pronouns | 0.309*** | N/A | 0.019 | Yeomans et al. (2018) |
| Auditory Perceptual Strength | 0.130* | N/A | 0.075 | Lynott & Connell (2009) |
| Declarations About One's Positive Traits | 0.392*** | N/A | 0.059 | Author Developed |
| ***Features Negatively Related to Warmth Condition*** | | | | |
| Starting Sentences with "I" | -0.295*** | N/A | -0.055 | Author Developed |
| Readability Index | -0.293*** | Y | -0.276*** | Benoit et al. (2018) |
| Number of Statements | -0.280*** | Y | -0.088** | Pennebaker et al. (2015) |
| Economic Words | -0.296*** | Y | -0.171*** | Moss et al. (2016) |
| Work-Related Language | -0.282*** | Y | -0.283*** | Pennebaker et al. (2015) |
| Numerical Modifiers (Measure 3) | -0.338*** | N/A | 0.003 | Author Developed |
| Numerical Modifiers (Measure 2) | -0.341*** | N/A | 0.007 | Author Developed |
| Datives | 0.012 | N/A | 0.005 | Author Developed |
| Passive Voice | -0.140*** | Y | -0.074* | Author Developed |

| | | | | |
|---|---|---|---|---|
| Hobby Words | -0.232*** | N/A | 0.061 | Author Developed |
| Interjections | -0.067 | N/A | -0.04 | Author Developed |
| Sex-Related Imagery | -0.103* | N/A | 0.026 | Martindale (1975) |
| Female References | -0.096* | N | 0.146*** | Pennebaker et al. (2015) |
| Water-Related Imagery | -0.102* | N/A | 0.005 | Martindale (1975) |
| Negation | 0.018 | N/A | -0.137*** | Yeomans et al. (2018) |
| Low Power | -0.170*** | N/A | 0.022 | Stone et al. (1966) |
| Numerical Modifiers (Measure 1) | -0.333*** | N/A | 0.004 | Pennebaker et al. (2015) |
| Food References | -0.164*** | N/A | 0.003 | Author Developed |
| "For Me" Phrase | -0.024 | N/A | -0.043 | Yeomans et al. (2018) |
| Words >6 Letters | -0.225*** | Y | -0.208*** | Pennebaker et al. (2015) |
| Swearing | -0.063 | N/A | -0.078* | Yeomans et al. (2018) |
| Odor-Related Imagery | -0.062 | N/A | 0.070* | Martindale (1975) |
| Use of Determiners | -0.153*** | Y | -0.163*** | Author Developed |

*Note*. Regression coefficients are standardized (columns 2 and 4). * $p < .05$, ** $p < .01$, *** $p < .001$. The second and third column is produced by running a series of regressions (one for each feature) where condition (control or competence) is the independent variable and the feature is the dependent variable. Features in the repository but not in the table had zero coefficients in the lasso model, indicating that they were least predictive of warmth signaling. See OSF Repository for operationalizations of the features.