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The quality of online knowledge sharing signals general intelligence☆

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ABSTRACT

Some people share knowledge online, often without tangible compensation. Who does this, when, and why? According to costly signaling theory people use behavioral displays to provide observers with useful information about traits or states in exchange for fitness benefits. We tested whether individuals higher in general intelligence, *g*, provided better quality contributions to an information pool under high than low identifiability, and whether observers could infer signaler *g* from contribution quality. Using a putative online wiki ($N = 98$) we found that as individuals' scores on Ravens Progressive Matrices (RPM) increased, participants were judged to have written better quality articles, but only when identifiable and not when anonymous. Further, the effect of RPM scores on inferred intelligence was mediated by article quality, but only when signalers were identifiable. Consistent with costly signaling theory, signalers are extrinsically motivated and observers act as "naive psychometricians." We discuss the implications for understanding online information pools and altruism.

1. The quality of online knowledge sharing signals general intelligence

Some people expend a great deal of time and energy sharing information online, often with little or no tangible compensation. These seemingly altruistic acts are key to the success of online public goods, such as Wikipedia, YouTube, and Reddit, which rely on the contributions of millions of disaggregated non-expert users. Information sharing has been studied across multiple disciplines (including psychology, information science, management, and communication), with most research exploring the social contexts in which knowledge sharing takes place and the affordances of knowledge sharing technologies (Argote, McEvily, & Reagans, 2003; Gibbs, Rozaidi, & Eisenberg, 2013; Leonardi, Huysman, & Steinfield, 2013; Schwämmlein & Wodzicki, 2012). However, questions remain about the motivations and individual differences that predict information sharing.

People contribute to information pools at a higher rate when they are publicly identified with their contributions (Cheshire & Antin, 2008), and when they perceive that their identities (personal and/or social) are verified by other group members (Ma & Agarwal, 2007). These findings suggest that identity verification evokes motivations for favorable social evaluations. Consistent with this hypothesis, Park, Chae, and Choi (2017) found that supervisor-ratings of employee knowledge sharing was greater among individuals high in the need for status, but only when task contributions were visible to supervisors.

While significant contribution rates are necessary to the success of online information pools, contributions alone are not sufficient. For an information pool to attract users it will be necessary that content is of high quality, otherwise time would be better spent elsewhere. Further, favorable responses from users and supervisors to higher quality contributions are likely to be motivating for contributors. For these reasons we expect that users of information pools will be attentive to information quality and the individuals who provide it. Indeed, Gray and Meister (2004) found that employees assess contributor expertise by evaluating the quality of contributions to information pools and use those assessments in evaluating and learning from those individuals.

Costly signaling theory (Grafen, 1990a, 1990b; Zahavi, 1975; Zahavi & Zahavi, 1997) predicts effects of motivations and individual differences on the quality of contributions to information pools. Costly signaling theory was designed to explain the evolution of secondary sexual characteristics, such as peacocks tails and elks antlers, but it has since expanded to explain a range of human social displays, including costly rituals (Sosis, Kress, & Boster, 2007), hazing (Cimino, 2011), conspicuous consumption (Griskevicius et al., 2007; Wang & Griskevicius, 2013), as well as competitive- (van Vugt & Hardy, 2010) and unconditional-altruism (Millet & Dewitte, 2007). People use social displays to communicate useful information about traits and states to observers. Individuals signal at a level commensurate with their quality

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(e.g., levels of creativity, intelligence, anger), and they are motivated to do so because observers provide them with fitness benefits (i.e., direct mating opportunities, or indirect fitness benefits such as resources and social status). Critically, higher quality individuals can better afford to signal at a higher intensity (e.g., provide better quality contributions to information pools) than lower quality individuals (e.g., in time and effort required for the same signal intensity). When the marginal costs of signaling intensely are greater for lower- than higher-quality individuals, cheating is disincentivized (i.e., individuals rarely signal beyond their quality because it is too costly), signal honesty is ensured (i.e., on average, signals reliably indicate quality), and thus observers can reliably discriminate between signalers of different quality.

But what trait might signalers communicate by contributing to information pools? We propose that contributions to information pools signal general intelligence (*g*; Spearman, 1927) and that signalers are motivated by reputational benefits. For observers, higher *g* individuals would make for better coalitional partners than lower *g* individuals because they would be better able to find, generate, and articulate useful information. It would therefore pay observers to discriminate between individuals who differ in *g*. Further, higher *g* individuals would be more able to rapidly acquire and articulate quality information than lower *g* individuals, making the marginal costs of signaling at a given intensity greater for lower *g* individuals. Cheating is thereby disincentivized, making contribution quality an honest signal of *g*.

For similar reasons, it has been hypothesized that unconditional altruism (i.e., the provision of benefits to others at apparent cost to oneself) is a costly signal of *g* (Jones, 2014; Millet & Dewitte, 2007; Osiński, Ostaszewski, & Karbowski, 2014). Likewise, the provision of higher quality contributions to information pools can be considered an unconditionally altruistic act, at least insofar that higher *g* individuals receive greater fitness benefits. If this is the case, higher *g* individuals should contribute better quality information than lower *g* individuals, but only when they and their contributions are identifiable to observers (Bereczkei, Birkas, & Kerekes, 2010; Lamba & Mace, 2010). Finally, observers must be able to reliably estimate *g* from information contributed, otherwise the signaling system could not operate. As far as we are aware these effects of signaler motivation and observer psychology have not been tested.

We manipulated identifiability experimentally (i.e., participants were either personally identifiable with their contribution or anonymous) and solicited contributions to an ostensible intra-departmental wiki. Observers blind to our hypotheses and experimental conditions rated contributions for quality and estimated the intelligence of contributors. We predict (H1) that as *g* increases individuals will provide better quality contributions to the wiki, but only when identifiable (i.e., not when anonymous, because extrinsic motivations must be operative if costly signaling theory is right). Further, observers will be able to reliably infer signaler *g* when signalers are identifiable (H2), which means (H3) that the effect of signaler *g* on observer-inferred *g* will be mediated by judgments of contribution quality—observers should act like “naive psychometricians”.

2. Method

2.1. Participants and design

One hundred and eighteen participants were recruited from an undergraduate research pool. In part 1 of the study we measured *g*, and in part 2 participants completed a wiki-style entry on their university while believing themselves to be anonymous or identifiable. Twenty participants failed to return for part 2, leaving $N = 98$ ($n = 28$ male; $M_{age} = 19.4$, $SD = 1.65$). Sample sizes were relatively even in the anonymous ($n = 38$) and identifiable conditions ($n = 40$), as was the gender composition across conditions. There was no evidence that participant RPM scores differed in the anonymous ($M = 20.87$) and identifiable conditions ($M = 20.33$ s), $F(1, 96) = 0.48$, $p = .49$. Participation was compensated with course credit. We aimed to recruit approximately 100 participants because research has established that scores on general intelligence are predictively valid estimates of performance and that the effect size should be of at least moderate size.

2.2. Materials and procedures

2.2.1. Part one

General intelligence, *g*, was assessed using Raven's Advanced Progressive Matrices (RPM). This test measures the “eductive ability” component of *g*; factor analytic studies have demonstrated that this test is among the most valid measures available (Raven, Raven, & Court, 1998). While the full test is allotted 40 min, this time limit can be reduced in light of experimental constraints (see Raven et al., 1998). The 20-min version is a reliable predictor ($r = 0.74$) of the 40-min version (Hamel & Schmittmann, 2006). Our participants were allotted 20 min.

2.2.2. Part two

Approximately one week after part 1 participants returned to contribute to an ostensibly real wiki-style encyclopedia being created by the Department of Communication. Participants were told that the wiki would serve as a repository of information for incoming first-year students and that it would contain entries related to campus life, culture, and academics. Participants were told that the wiki was being pilot tested and that their participation would help the researcher gain insight into the wiki creation process. Participants completed their entries in private cubicles on a computer. The wiki resembled Wikipedia and contained a collection of preliminary articles that were created by an undergraduate research assistant.

Participants were told that they could contribute as many entries to the wiki with as little or as much content as they would like (all participants wrote an entry). The choice of topic was left up to participants, but they were supplied with a list of sample topics, including classes, professors, a local bar, a campus event and so on. Participants typed their contributions into a word-processing document and were told that they could use any information that they could find online (with the exception of images). Participants were given 30 min to make their contribution.

2.2.3. Identifiability induction

In the identifiable condition, participants were photographed and told that their photo would be placed next to their contribution. Participants' names were also entered into the word-processor document that contained their contribution. In the anonymous condition participants' photos were not taken and their names were not associated with their contributions.

2.2.4. Dependent measures

The quality of all participants' contributions was rated by four undergraduate research assistants who were blind to hypotheses and experimental conditions. Research assistants were told that the articles were contributions to a departmental wiki, and were asked to use their subjective judgments to “describe the quality” of each article on a 7-point Likert-type scale (1 *Very low quality*, 7 *Very high quality*). The research assistants also judged the contributors' intelligence relative to other participants using a 7-point Likert-type scale (1 *Much dumber than average*, 7 *Much smarter than average*). If intelligence is signaled via writing samples, then participants should agree relatively strongly with no formal training. Intraclass correlations (ICCs) were computed to test for levels of interrater reliability using a two-way random effects model (see Shrout & Fleiss, 1979). The ICCs were 0.67 for quality and 0.57 for intelligence. As expected, observers were in relatively strong agreement in their assessments of signalers.

The size of the wiki contributions was measured using the word count of participants' wiki entries. Word count ($M = 330.56$, $SD = 165.09$) was included as a covariate because entry length and

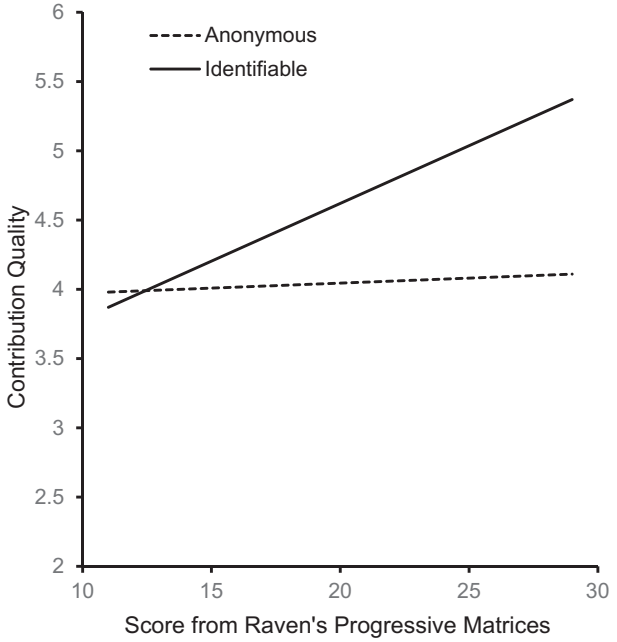

Fig. 1. Individuals with higher RPM scores provide better quality contributions, but only when identifiable to observers (with control for word count).

quality were expected to be correlated (cf. Reynolds Jr. & Gifford, 2001), and they were, $r = 0.50$, $p < .001$. If a participant wrote multiple entries, the word count was summed across the aggregate of all entries. Word count was skewed but normalized with a logarithmic transformation.

3. Results

H1 predicted that higher RPM scores would be associated with stronger article quality ratings, and that this association would be most apparent when participants were identifiable. We tested H1 using a regression model with RPM as a mean centered moderator of experimental condition and entry length as a covariate. Word count was positively associated with entry quality, b = 0.003, $t(93) = 6.52$, $p < .001$, β = 0.55. As RPM increased so did perceived entry quality, b = 0.06, $t(93) = 2.81$, $p = .006$, β = 0.23, and quality ratings were higher in the identifiable ($M = 4.44$) than anonymous condition ($M = 4.05$), b = 0.20, $t(93) = 2.47$, $p = .015$, β = 0.20. There was also evidence for the predicted interaction, b = 0.20, $t(93) = 2.41$, $p = .018$, β = 0.20. Simple slopes tests (see Fig. 1) show that the slope of RPM on quality was positive and significant in the identifiable condition, b = 0.11, $t(93) = 3.98$, $p < .001$, β = 0.44, but non-significant in the anonymous condition, b = 0.007, $t(93) = 0.21$, $p = .83$, β = 0.03. Further, high RPM (+1SD on RPM) participants' quality scores were higher in the identifiable than anonymous condition, b = 0.79, $t(93) = 3.49$, $p = .001$, β = 0.41. For low RPM participants, however (−1 SD on RPM), the condition effect was non-significant, b = 0.008, $t(93) = 0.03$, $p = .97$, β = 0.004.

H2 predicted that observer estimates of signaler RPM would be positively associated with actual RPM, particularly under conditions of identifiability. Using the same regression model, word count was positively associated with perceived intelligence, b = 0.001, $t(93) = 3.56$, $p = .001$, β = 0.34. As RPM increased so did the perceived intelligence of the writer, b = 0.04, $t(93) = 2.28$, $p = .025$, β = 0.21. Further, perceived intelligence was higher in the identifiable ($M = 4.29$) than anonymous condition ($M = 4.04$), b = 0.13, $t(93) = 2.04$, $p = .04$, β = 0.19. There was also evidence for a marginally significant interaction, b = 0.03, $t(93) = 1.64$, $p = .11$, β = 0.16. Simple slopes analysis showed that the slope of RPM on perceived intelligence was positive and significant in the identifiable condition, b = 0.07, $t(93) = 2.98$, $p = .004$, β = 0.37, but non-significant in the anonymous condition, b = 0.01, $t(93) = 0.39$, $p = .70$, β = 0.06. Further, high RPM (+1SD on RPM) participants' were judged more intelligent in the identifiable than anonymous condition, b = 0.48, $t(93) = 2.62$, $p = .01$, β = 0.35. For low RPM participants, however (−1 SD on RPM), the condition effect was non-significant, b = 0.04, $t(93) = 0.23$, $p = .82$, β = 0.03. These findings confirmed H2.

H3 predicted that the relationship between RPM and perceived intelligence would be mediated by article quality judgments, but only in the identifiable condition. Regression analysis, with word count controlled, showed that within the identifiable condition RPM predicted inferred intelligence, b = 0.07, $t(93) = 2.98$, $p = .004$; RPM predicted the mediator, article quality, b = 0.11, $t(93) = 3.98$, $p < .011$, and article quality predicted inferred intelligence, b = 0.60, $t(92) = 10.74$, $p < .001$. However, in the anonymous condition there was no evidence that RPM predicted inferred intelligence, b = 0.01, $t(93) = 0.39$, $p = .70$, and no evidence that RPM predicted article quality, b = 0.007, $t(93) = 0.21$, $p = .83$.

As an inferential test of H3 we used Hayes' PROCESS module for SPSS. A conditional indirect effect model (model 7) tested whether the mediational path linking RPM to inferred intelligence through the perceived quality of the contribution was stronger in the identifiable than anonymous condition (see Hayes, 2015). In this model condition moderated the effect of RPM on judgements of article quality, and the number of words in the article was controlled. A bias-corrected bootstrap was ran with 10,000 resamples. The 95% confidence intervals showed that the indirect effect of RPM on inferred intelligence was mediated through article quality in the identifiable condition (0.03, 0.11) but not in the anonymous condition (−0.03, 0.04). Further, the index of moderated mediation (−0.06) was significant at the 95% level (−0.12, −0.01), showing that the mediational model was a significantly stronger fit in the identifiable than anonymous condition, confirming H3.

4. Discussion

Using an experimentally simulated online wiki, we found that higher *g* individuals were judged (by observers blind to experimental conditions and hypotheses) to have made better quality contributions than lower *g* individuals, but only when contributions were made under identifiable conditions. We also found that observers accurately inferred signaler *g* by judging the quality of their contributions to the wiki, but also only when signalers believed that they and their contributions were identifiable. We believe these findings add to our understanding of online information pools, the costly-signaling explanation for altruism, and the observer psychology associated with judging signalers and their traits.

Our findings are consistent with the costly signaling hypothesis that individuals who contribute to information pools do so to signal their intelligence, and only do so when the prospects of a reward is a possibility—signalers are ultimately genetically selfish and will signal when the prospects of a payoff exist, but not otherwise. These findings build on social scientific work on information exchange in organizations (Argote et al., 2003; Gibbs et al., 2013; Leonardi et al., 2013; Schwämmlein & Wodzicki, 2012), as well as work on motivational and individual difference effects on information sharing (Cheshire & Antin, 2008; Ma & Agarwal, 2007; Park et al., 2017). While our findings do not address technological affordances or organizational structures, it is possible that information exchange in these contexts could be better understood by taking motivations for information sharing and intelligence signaling into account. It is of course plausible that different technologies and organizational structures will promote different motivations and select for the signaling of different traits, but it is likely that costly signaling theory will provide a useful framework for understanding such processes.

Our findings are also consistent with the costly signaling theory of altruism, and more broadly with the selfish gene hypothesis. By definition, genes that confer fitness enhancing phenotypes increase in frequency in the population whereas genes that confer fitness diminishing phenotypes decrease in frequency. Thus, from a selfish gene perspective altruism (i.e., the act of conferring fitness benefits to others at cost to oneself) should be rare, and yet altruism seems common (Dawkins, 1976; Hamilton, 1964; Williams, 1966). Because sites such as Wikipedia, Reddit, and YouTube typically do not provide tangible compensation, and because users are not required to contribute, many contributions appear to be unconditionally altruistic and the system vulnerable to free riding. If the selfish gene hypothesis is correct, however, altruism must be apparent and compensated with fitness benefits. As such, our findings add to previous work that tests the costly signaling theory explanations for altruism, of which there are several (e.g., Bereczkei et al., 2010; Gurven, Allen-Arave, Hill, & Hurtado, 2000; Lotem, Fishman, & Stone, 2002; Millet & Dewitte, 2007; Smith & Blige Bird, 2000; Zahavi, 1995). Previous research has tended to involve analysis and interpretation of real world behaviors like hunting (Smith & Blige Bird, 2000) and food sharing (Gurven et al., 2000) outside of experimental control, whereas work that has considered altruism in laboratory conditions have tended to consider only one piece of the costly signaling explanation, as well as dependent measures that are relatively low in ecological validity.

Our findings are also consistent with Millet and Dewitte's (2007) hypothesis that altruism is a signal of *g*. Unlike previous research which used economic games (i.e., Jones, 2014; Millet & Dewitte, 2007; Osiński et al., 2014), we used a relatively ecologically valid, free-response measure which involved contributions to a putative online wiki. Our findings constitute a relatively stringent test of costly-signaling theory in that both signaler motives and observer decoding abilities are requirements for the theory to successfully explain contributions to information pools, and unconditional altruism more broadly. As far as we are aware, the effects of identifiability and observer response psychology have not been tested in work on unconditional altruism. Our findings suggest that observers function as reliable “naive psychometricians”, decoding others' intelligence from their contributions.

Nonetheless, it is plausible that there exist individual differences in the ability to accurately discern signaler intelligence. As Miller (2001) points out in his discussion of intelligence in mate selection, the ability to detect intelligence in others is dependent on the intelligence of the observer. This same fact may extend to the technical domain, where observers are able to accurately infer the intelligence of others, but only up to a point—an “extended” Dunning-Kruger effect in which people are unable to accurately determine the intelligence of others who are much more intelligent than themselves. Our sample of university students may have mitigated against such an effect, as the range of intelligences would be narrow compared with the general population. At the same time, we would note that this restriction of range on intelligence would have worked against the statistical power of our tests, and thus confirmation of our hypotheses. We would therefore expect our findings to hold more strongly if tested in a real-world information pool that has a greater range of intelligence in contributors and observers.

However, several important questions remain. First, it remains unclear what benefits are gained by signalers who contribute to information pools. Signaling may increase social status (Burling, 1986; Dessalles, 1998; Miller, 2001), perceived trustworthiness (Barclay, 2004), and potential as a coalitional partner or mate. While research demonstrates links between *g*, humor, and reproductive success (Greengross & Miller, 2011), we doubt a direct relationship to reproductive success for altruism in signaling *g* in information pools. Technical abilities are not particularly sexually attractive (Kaufman et al., 2014), so it is likely that *g* mediates indirect fitness benefits in such contexts.

Second, theory and research suggests that trust is key to altruism, and that trust involves reputation management through social communication (see Barclay, 2013). If both trust and *g* are considerations in altruism, how are they related in the signaling process? An intriguing and unexamined possibility is that observers solve for dual and concurrent signals of *g* and trustworthiness (i.e., that people post information that they believe to be true). In principle, solving for dual signals should bring benefits to observers, at least in technical domains where ability (and thus *g*) matters. A highly trustworthy but low *g* signaler would not be particularly valuable to observers because they cannot solve problems well and provide fitness benefits; their contributions would be honest but banal. A high *g* but low trustworthiness signaler would also be unappealing, perhaps particularly so as high *g* could be used to cheat and thereby inflict fiendish costs on observers. Of course, low *g* and low trust individuals would lack redemption for observers, and their socially undesirable natures would probably inflict inadvertent costs on observers. Ideally, observers would wish to identify signalers high on *g* and trustworthiness as they would have the greatest potential for providing benefits, as well as avoiding the costs associated with the other combinations of *g* and trustworthiness. Theoretical and empirical challenges would need to be met to test this multiple-message hypothesis.

Third, there are no direct tests of hypotheses regarding the costs that maintain signal honesty for *g*. If Millet and Dewitte (2007) are correct that altruism is less costly for high *g* individuals, then the ability to recoup resources lost through non-compensated altruism should be greater for high *g* individuals. Further, higher *g* individuals should use less metabolic resources when solving the same number of problems (say Raven's RPM) than lower *g* individuals.

Finally, our findings show that the relationship between RPM and performance were affected by motivation. Future research might explore the extent to which intelligence signaling is under control of motivational factors, which has interesting implications for research on the predictive validity of *g* on life outcomes such as occupational prestige and salary (Jensen, 1998). Our findings suggest that the relationship between *g* and favorable life outcomes will be greatest when people have more abundant opportunities to signal their worth to observers. At the same time, however, such reward systems have the potential to amplify status competition, leading to the emergence of greater inequality in payoffs. The evoked culture of costly signaling processes would make for an interesting avenue for future work.

References

Argote, L., McEvily, B., & Reagans, R. (2003). Managing knowledge in organizations: An integrative framework and review of emerging themes. *Management Science, 49*, 571–582.

Barclay, P. (2004). Trustworthiness and competitive altruism can also solve the “tragedy of the commons”. *Evolution and Human Behavior, 25*, 209–220.

Barclay, P. (2013). Strategies for cooperation in biological markets, especially for humans. *Evolution and Human Behavior, 34*, 164–175.

Bereczkei, T., Birkas, B., & Kerekes, Z. (2010). Altruism towards strangers in need: Costly signaling in an industrial society. *Evolution and Human Behavior, 31*, 95–103.

Burling, R. (1986). The selective advantage of complex language. *Ethology and Sociobiology, 7*, 1–16.

Cheshire, C., & Antin, J. (2008). The social psychological effects of feedback on the production of internet information pools. *Journal of Computer-Mediated Communication, 13*, 705–727.

Cimino, A. (2011). The evolution of hazing: Motivational mechanisms and the abuse of newcomers. *Journal of Cognition and Culture, 11*, 241–267.

Dawkins, R. (1976). *The selfish gene.* Oxford: Oxford University Press.

Dessalles, J. L. (1998). Altruism, status and the origin of relevance. In J. R. Hurford, M. Studdert-Kennedy, & C. Knight (Eds.). *Approaches to the evolution of language* (pp. 130–147). Cambridge: Cambridge University Press.

Gibbs, J. L., Rozaidi, N., & Eisenberg, J. (2013). Overcoming the “ideology of openness”: Probing the affordances of social media for organizational knowledge sharing. *Journal of Computer-Mediated Communication, 19*, 102–120.

Grafen, A. (1990a). Sexual selection unhandicapped by the fisher process. *Journal of Theoretical Biology, 144*, 473–516.

Grafen, A. (1990b). Biological signals as handicaps. *Journal of Theoretical Biology, 144*, 517–546.

Gray, P. H., & Meister, D. B. (2004). Knowledge sourcing effectiveness. *Management Science, 50*, 821–834.

Greengross, G., & Miller, G. (2011). Humor ability reveals intelligence, predicts mating success, and is higher in males. *Intelligence, 39*, 188–192.
Griskevicius, V., Tybur, J. M., Sundie, J. M., Cialdini, R. B., Miller, G. F., & Kenrick, D. T. (2007). Blatant benevolence and conspicuous consumption: When romantic motives elicit strategic costly signals. *Journal of Personality and Social Psychology, 93*, 85–102.
Gurven, M., Allen-Arave, W., Hill, K., & Hurtado, M. (2000). "It's a wonderful life": Signaling generosity among the ache of Paraguay. *Evolution and Human Behavior, 21*, 263 – 282.
Hamel, R., & Schmittmann, V. D. (2006). The 20-minute version as a predictor of the Raven advanced progressive matrices test. *Educational and Psychological Measurement, 66*, 1039–1056.
Hamilton, W. D. (1964). The genetical evolution of social behaviour, 1. *Journal of Theoretical Biology, 7*, 1–16.
Hayes, A. F. (2015). An index and test of linear moderated mediation. *Multivariate Behavioral Research, 50*, 1–22.
Jensen, A. R. (1998). *The g factor: The science of mental ability.* Westport, CT: Praeger.
Jones, M. T. (2014). Strategic complexity and cooperation: An experimental study. *Journal of Economic Behavior & Organization, 106*, 352–366.
Kaufman, S. B., Kozbelt, A., Silvia, P., Kaufman, J. C., Ramesh, S., & Feist, G. J. (2014). Who finds Bill Gates sexy? Creative mate preferences as a function of cognitive ability, personality, and creative achievement. *The Journal of Creative Behavior, 0*, 1–19.
Lamba, S., & Mace, R. (2010). People recognize when they are really anonymous in an economic game. *Evolution and Human Behavior, 31*, 271–278.
Leonardi, P. M., Huysman, M., & Steinfield, C. (2013). Enterprise social media: Definition, history, and prospects for the study of social technologies in organizations. *Journal of Computer-Mediated Communication, 19*, 1–19.
Lotem, A., Fishman, M. A., & Stone, L. (2002). From reciprocity to unconditional altruism through signaling benefits. *Proceedings of the Royal Society of London, Series B, 270*, 199–205.
Ma, M., & Agarwal, R. (2007). Through a glass darkly: Information technology design, identity verification, and knowledge contribution in online communities. *Information Systems Research, 18*, 42–67.
Miller, G. F. (2001). *The mating mind: How sexual choice shaped the evolution of human nature.* London: Vintage/Ebury.
Millet, K., & Dewitte, S. (2007). Altruistic behavior as a costly signal of general intelligence. *Journal of Research in Personality, 41*, 316–326.
Osiński, J. T., Ostaszewski, P., & Karbowski, A. (2014). Social discounting rate is negatively correlated with fluid intelligence. *Personality and Individual Differences, 59*, 44–49.
Park, J., Chae, H., & Choi, J. N. (2017). The need for status as a hidden motive of knowledge- sharing behavior: An application of costly signaling theory. *Human Performance, 30*, 21–37.
Raven, J., Raven, J. C., & Court, J. H. (1998). *Manual for Raven's progressive matrices and vocabulary scales.* San Antonio, TX: Harcourt Assessment.
Reynolds, J. D., Jr., & Gifford, R. (2001). The sounds and sights of intelligence: A lens model channel analysis. *Personality and Social Psychology Bulletin, 27*, 187–200.
Schwämmlein, E., & Wodzicki, K. (2012). What to tell about me? Self-presentation in online communities. *Journal of Computer-Mediated Communication, 17*, 387–407.
Shrout, P. E., & Fleiss, J. L. (1979). Intraclass correlations: Uses in assessing rater reliability. *Psychological Bulletin, 86*, 420–428.
Smith, E. A., & Blige Bird, R. (2000). Turtle hunting and tombstone opening: Public generosity as costly signaling. *Evolution and Human Behavior, 21*, 245–261.
Sosis, R., Kress, H. C., & Boster, J. S. (2007). Scars for war: Evaluating alternative signaling explanations for cross-cultural variance in ritual costs. *Evolution and Human Behavior, 28*, 234–247.
Spearman, C. (1927). *The abilities of man. Their nature and measurement.* London: MacMillan.
van Vugt, M., & Hardy, C. L. (2010). Cooperation for reputation: Wasteful contributions as costly signals in public goods. *Group Processes & Intergroup Relations, 13*, 101–111.
Wang, Y., & Griskevicius, V. (2013). Conspicuous consumption, relationships, and rivals: Women's luxury products as signals to other women. *Journal of Consumer Research, 40*, 834–854.
Williams, G. C. (1966). *Adaptation and natural selection: A critique of some current evolutionary thought.* Princeton, New Jersey: Princeton University Press.
Zahavi, A. (1975). Mate selection: A selection for a handicap. *Journal of Theoretical Biology, 53*, 205–214.
Zahavi, A. (1995). Altruism as a handicap: The limitations of kin selection and reciprocity. *Journal of Avian Biology, 26*, 1–3.
Zahavi, A., & Zahavi, A. (1997). *The handicap principle: A missing piece of Darwin's puzzle.* Oxford, UK: Oxford University Press.