

# The Effects of Visualizing Activity History on Attitudes and Behaviors in a Peer Production Context

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## ABSTRACT

In a variety of peer production settings, from Wikipedia to open source software development to crowdsourcing, individuals may encounter, edit, or review the work of unknown others. Typically this is done without much context to the person's past behavior or performance. To understand how exposure to an unknown individual's activity history influences attitudes and behaviors, we conducted an online experiment on Mechanical Turk varying the content, quality, and presentation of information about another Turker's work history. Surprisingly, negative work history did not lead to negative outcomes, but in contrast, a positive work history led to positive initial impressions that persisted in the face of contrary information. This work provides insight into the impact of activity history design factors on psychological and behavioral outcomes that can be of use in other related settings.

## Author Keywords

Crowdsourcing; Peer production; Activity traces; Transparency; Bias

## ACM Classification Keywords

H.5.2 [Information Interfaces and Presentation]: User Interfaces - Interaction styles.

## General Terms

Human Factors; Design; Measurement.

## INTRODUCTION

As social media functionalities become more integrated into online work environments, details about individuals' work and interaction histories become increasingly visible. For example, sites like GitHub visibly showcase software developers' work history traces in a variety of formats that give insight into their past behavior and can be a source of learning [4]. External observers have access to these traces

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to learn about individuals' past work, which can help them to form an initial impression of this person's areas of expertise [13]. For example, in an enterprise social media setting, public online activity traces can also be used to infer connections between individuals relating to various aspects of expertise and reputation [7].

Other sites like Wikipedia and Stack Overflow make different design choices in terms of how they present information about users' activity history in varying degrees of accessibility and granularity. There are tradeoffs between aggregating information about activity, such that focusing only on quantitative properties of user behavior (e.g. reputation score, number of answers) can cause people to misclassify active users for knowledgeable ones, or be subject to manipulation [23].

However, the effects of exposure to past traces of activity history in evaluating work done by an unknown individual are not well understood, particularly in a peer review setting where individuals review and correct each other's work. On one hand, making activity history visible can provide useful insight into details of behaviors that previously were inaccessible and encourage more careful review of difficult cases [5].

On the other hand, large amounts of detailed information could be overwhelming and lead to cognitive overload. The way in which the details are presented may be able to mitigate problems of information overload if they are presented in a summary. However, summaries may obscure some of the useful details.

To investigate these competing potential outcomes, we conducted an online experiment looking at the effects of activity history presentation on evaluation of an unknown individual's work in an online peer review/peer production context. Our research questions were as follows:

*RQ1. How does exposure to information about an individual's work history influence initial attitudes and behaviors towards that person?*

*RQ2. How does subsequent experience with the individual's work artifacts influence final impressions of that person and editing behaviors on their work?*

*RQ3. How does the design and presentation of work history information influence final impressions of that person and editing behaviors on their work?*

This work builds upon previous research in the areas of online impression formation and peer production by examining how interpersonal impressions can change over time and how they relate to work-related decision-making and evaluation.

#### RELATED WORK

Typically, information available about others in peer production contexts like Wikipedia or social Q&A sites is limited. The impact of providing detailed information about a stranger's work history on attitudes and behaviors towards that person is not well known. As Tausczik & Pennebaker [18] point out, minimizing information about a person's activity (e.g. what they have done in the past) can give individuals with little or no reputation the opportunity to produce high quality content. However, the reverse is also true: seeing a user's reputation could be a useful heuristic for assessing the quality of their work and making it easier to identify high quality content. We therefore hypothesize that if work history is seen as indicative of an individual's past performance, then

H1: The valence of work history should inform initial impressions of the person (e.g. a good work history should lead to more positive first impressions than a bad history.)

#### Advantages of seeing work history and process

One advantage of access to an individual's work process is the fact that aggregated history of behavior should, overall, provide a good basis for reputation even if an individual might behave differently across specific interactions [1]. Work looking at the effects of exposure to different types of discussion histories for Wikipedia articles suggests that access to more information about how an article was written (specifically, how much conflict there was between editors) can shape readers' attitudes towards the quality of an article [19]. In this case, evidence of negative conflicts decreased readers' perceptions of the actual work quality. However, we do not know how exposure to conflict also affected perceptions of the articles' authors.

Qualitative research has provided some insights in this regard. In creative collaborations, Luther et al. [12] found that access to an individual's past work influenced how project leaders evaluated candidates. They equated a high "batting average" (reputation) and evidence of a long activity history with competence and expected them to be able to contribute to a project's success. Similar patterns have been observed in open source software development [13], but these findings have not been experimentally tested.

#### Bias

As Walther [21] asserts, lack of rich cues in a text-based digital environment can often make information seeking and interpretation cognitively demanding and subject to

errors. Despite this, research on impression formation online suggests that first impressions are often unexpectedly robust, although they can be both confirmed and disconfirmed [22].

The potential disadvantage of access to work history is that people may be subject to bias based on whatever they see. When viewers are not motivated or unable to systematically evaluate information, they may be subject to using heuristic shortcuts or cues instead [14]. For example, the confirmation bias can cause individuals to form an initial impression and interpret subsequent information in light of this impression. This can be a problem when making social judgments in cases where the initial impression is inaccurate [6].

In general, the valence of information may also affect the nature of biases formed. While positive stimuli may elicit positive inferences (a positivity bias), and negative stimuli may elicit a negativity bias [16], negative information is often stronger and more influential than positive information [2]. Past work suggests that negative first impressions are often more resistant to change, and negative information is more likely than positive information to have an enduring effect [8].

Prior research on interactions around contributions in peer production provides some evidence of the negativity bias occurring, particularly towards contributors who are perceived to be novices [13, 24]. Based on this, we might expect that a negative first impression of a person will be less likely to change than a positive first impression, even in the face of disconfirming information.

H2a: Initial impressions will persist even in the face of contrary evidence.

H2b: Individuals will change their opinions after new evidence is revealed.

#### Visualizations of behavior

Past work in a variety of online domains have explored the effects of using simple interface interventions to help people make sense of detailed and potentially overwhelming information about the past behavior of individuals and the artifacts that they create. For example, Liao & Fu have used various indicators of unknown online forum commenters' attitudes and expertise to help increase accuracy of perceptions of these commenters' positions and knowledge [10, 11]. Other research in the realm of peer production has focused on different ways of presenting and displaying information about work history. For example, work in Wikipedia explored ways of visualizing an article's edit history to indicate quality [3].

Psychological principles underlying visualization design may affect the way people interpret the information displayed. Large volumes of information can be presented in great detail or aggregated into a more visual format. This has implications for the amount of processing effort it takes

to make sense of the information. For example, work that is harder to perceive (such as text written in a font that is hard to read) requires more mental effort to process, and this has been found to lead to more negative impressions of the text’s author [15]. This work suggests the easier a display is to process, the more positive feelings it may engender, thus we hypothesize:

H3a: Reducing the amount of detail in the work history will increase impression positivity.

Reducing detail by summarizing the information could be beneficial, by reducing information overload (which can impose a ceiling on accuracy [20] and make people more subject to bias). At the same time, even uninformative details may increase the clarity of the judge’s mental picture of the target [20], which has been associated with increased positive attitudes towards others [17].

H3b: Increasing the amount of detailed information about another worker will increase impression positivity.

In the present research we were therefore interested in exploring the tradeoffs between useful detail and potential information overload by examining when and how presenting information about a worker’s past history influences attitudes and subsequent behaviors towards that person and their work.

**THE EFFECTS OF WORK HISTORY AND PRESENTATION ON ATTITUDES AND BEHAVIORS**

In this study we were interested in understanding the relative effects of work history valence (positive or negative) on subsequent evaluations of that person’s work. We also examined the role of information presentation (i.e. the level of detail provided) on impressions and behaviors. To do so, we conducted an online experiment on Mechanical Turk where participants first viewed a worker’s past history and then went on to rate and edit new examples of their work.

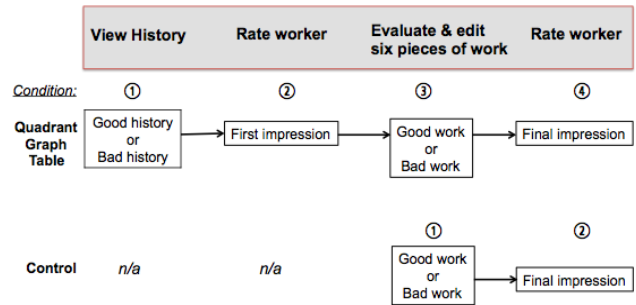
**METHOD  
Procedure**

Participants were recruited from Amazon’s Mechanical Turk to complete what was advertised as a “transcription evaluation” task. The task was posted on January 6, 2014 and we provided a payment of 25 cents for successful completion. Participants were told that the requesters were having people on Mechanical Turk type in the text from images of signs to help compile a database of transcriptions, and that we needed help from other Turkers to check them for quality.

Participants were then told they would first see some information about the past performance of the person whose work they were about to evaluate, including how other “editors” had evaluated their work. After this, participants were then told that they would be shown six new pieces of work that had not been evaluated yet. They were asked to rate the quality of the work and had the option to edit it if needed. After rating the six pieces of new work,

participants completed a short questionnaire in which they evaluated the overall quality of the worker, gave a recommendation for using this person for future tasks, and provided demographic information such as age and gender.

Figure 1 summarizes the overall experimental flow:



**Figure 1. Overall experimental flow and manipulations**

**Independent variables**

We manipulated three independent variables: Work history visualization (3 types: *table*, *graph*, or *quadrant*), work history quality (2 types: good history or bad history), and quality of work to be evaluated (2 types: good work or bad work), for a total of twelve different experimental conditions. We also had two *control* conditions, where participants did not see any history information and evaluated either good or bad work. There were therefore a total of fourteen potential conditions and each participant was randomly assigned to one of these.

**Work history visualization**

Participants in the work history conditions saw information about how the worker they were evaluating had previously performed on transcribing six images, along with how their work was evaluated by another editor. The visualizations differed in terms of the amount of detail they presented and the degree to which this was listed in textual format or displayed in a more abstract, visual way.

The *table* condition involved a grid filled with the text the participant had typed, the correct answer, the rating by the editor, and the percent of the work that had been completed. The *graph* condition contained this same information, except the percent of the work completed and the rating by the editor were displayed in a visual format (through colored bar graphs.) Finally, the *quadrant* condition was the most abstract and plotted the participant on a grid showing the average completeness of their work and the average evaluation of their work.

Because we were interested in varying the amount of detail and in varying the difficulty of processing the information, the table was designed to be the most detailed but also the hardest to process. The graph was designed to present activity information in a visual summary, using color and visual cues to help make it easier to process. The quadrant was designed as an alternative, easy to process visualization to make sure the particular design of the graph itself was

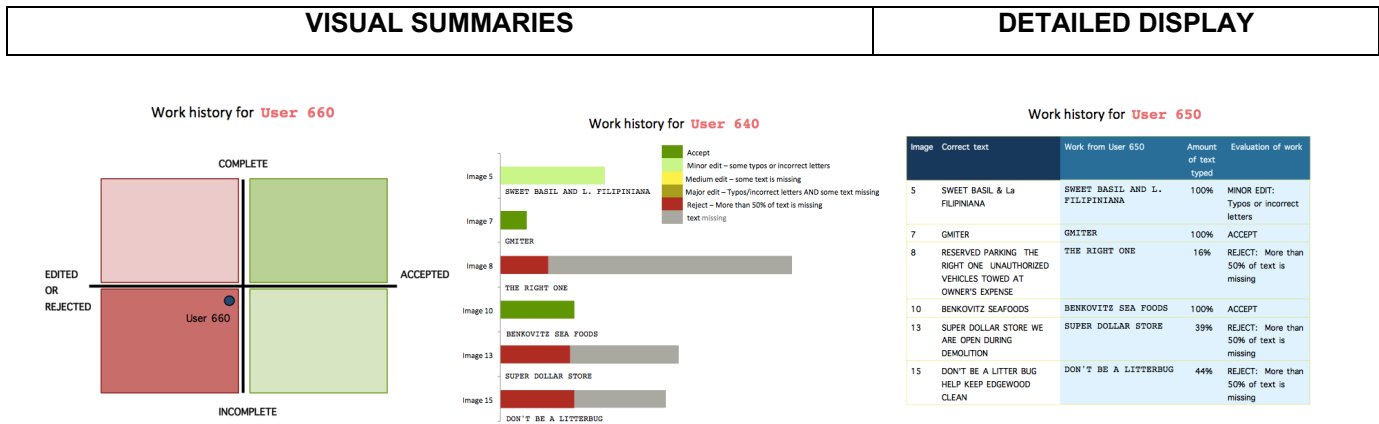


Figure 2. Examples of bad work shown, from left to right: summary (quadrant, graph) and detail (table) formats

not responsible for any observed effects. We used two different visual summaries to ensure that any differences between the table and the visual summaries was due to the difference in abstraction rather than the particular representation chosen (see Figure 2).

*Work history quality*

We were also interested in how the quality of past work influenced attitudes towards subsequent work (H1). Therefore, we manipulated the quality of the work shown in the past history and in the six examples. The work shown was taken from actual activity history taken from Turkers who had performed the image transcription task previously.

Figure 2 shows an example of the three visualization formats we used (in this case, showcasing “bad” work history). Participants in the control condition were not exposed to any of these work history visualizations. They viewed a neutral image (to ensure that they were still looking at something prior to beginning the work) but this was unrelated to the person whose work they were about to evaluate.

*Stimuli used for work quality evaluation*

For the work task, participants were shown six new images along with the worker’s performance transcribing the image. The instructions for evaluating the work were as follows: *We would like the text transcribed to be as complete a representation of everything in the image as possible. The capitalization of letters does not matter.*



Figure 3. Sample image for transcription

Figure 3 shows one of the sample images used; below are examples of “good” and “bad” work.

Example of correctly transcribed text: STAGNO’S BAKERY INC. STAGNOS BAKERY

Example of “good” work: STAGNO'S BAKERY INC. STANGNOS [missing 6 characters]

Example of “bad” work: STAGNO’S BAKERY [missing 18 characters]

**Dependent variables**

There were four dependent measures: 1) *First work impression*: The initial impression of the quality of the Turker’s past work, measured on a scale from 1-100, after viewing the history; 2) *Work evaluation*: The mean of the six quality ratings given for the pieces of work seen, on a five point Likert scale; 3) *Amount of work fixed*: A measure of relative amount of work edited, calculated as the average increase in number of characters from the original work to the participants’ answer, and 4) *Final impression*: The aggregate sum of four five-point Likert scale items assessing overall impressions of the quality of the Turker’s work.

**RESULTS**

Overall, 284 participants completed the task (which had an overall completion rate of 82%). 55% were female, and 45% were male. 59% were located in the USA, 35% in India, and 6% in other countries.

*RQ1: Attitudinal and behavioral effects of work history*

We initially predicted that the valence of work history would influence initial impressions of the person. We conducted a one-way ANOVA to assess the effects of work history on first impression (on a 100-point scale, with 100 being the highest quality.) This was supported; participants exposed to the “good” work history gave a significantly higher rating of the quality of the Turker’s past work (75.94 out of 100) than participants exposed to the “bad” history (33.39 out of 100) ( $F(1,217)=329.72, p<.001$ ).

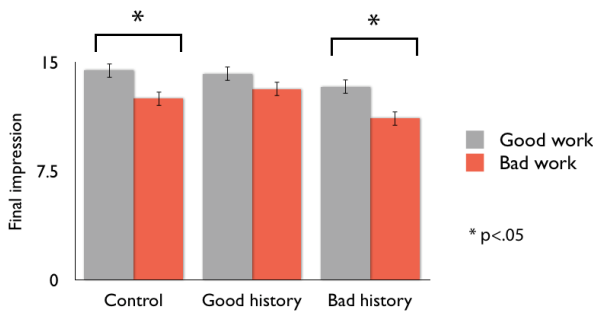
This suggests that participants were able to fairly accurately assess work quality and correctly interpreted the history visualizations.

*RQ2: Relationship between initial impression and direct experience with work*

RQ2 focused on the degree to which an initial impression was subject to influence or change after direct experience viewing and editing the Turker’s work artifacts.

There was a significant main effect of work quality, which is to say that participants exposed to “bad” work rated it, on average, significantly lower (mean rating for six pieces of work=3.97) than “good” work (4.29) ( $F(1,282)=322.22, p<.001$ ).

Hypotheses 2a and 2b focused on the persistence of initial first impressions after direct exposure to work. In order to test these, we conducted a series of paired t-tests comparing final impressions within each set of history conditions.



**Figure 4. Effects of history and work on final impression**

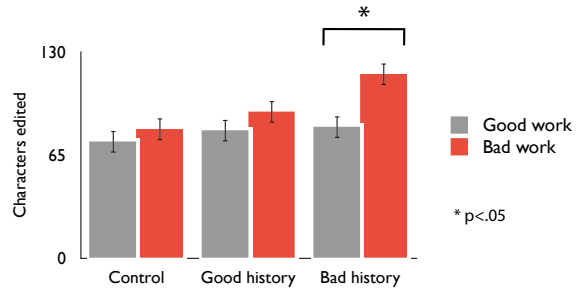
As indicated in Figure 4, participants in the control and bad history conditions had differing impressions of the worker based on the quality of the work they evaluated themselves. When participants had no history to go on (in the control condition), they formed impressions of people in accordance with the work that they saw; final impressions of good work were significantly higher than final impressions of bad work ( $t[63]=2.49, p=.01$ ). Similarly, when the work history was bad, then participants’ final impressions of the worker were, like in the control condition, more based upon the work that they saw, with “good” workers viewed as better than “bad” workers ( $t[108]=3.01, p<.005$ ).

However, when the work history was good, then subsequent work quality had no effect on the final impressions of the person ( $t[107]=2.69, p=.10$ ). This suggests the presence of a “positivity effect” and confirmation bias when the history was good, but no such effects when the history was bad.

When comparing the effects of work quality on editing behaviors within history quality types, there was a significant difference in editing behaviors (number of characters edited) in the bad history condition (see Figure 5). Individuals in the bad history condition edited more bad

work than good work ( $t[108]=-3.09, p<.0025$ ). This pattern was not observed for the control condition ( $t[63]=-.74, p=.46$ ) or the good history condition ( $t[107]=-1.25, p=.21$ ).

Therefore, we found partial support for both Hypothesis 2a and 2b, depending on the valence of the history information. People who viewed a good history formed impressions that were resistant to change, while people who viewed a bad history were able to change their opinions in the face of new evidence. The bad history also seems to have made people more sensitive to fixing work when it was needed.



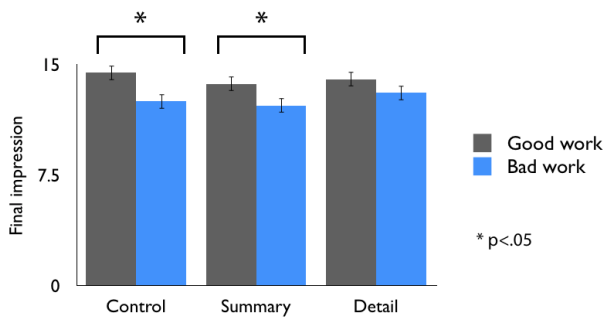
**Figure 5. Effects of history and work on amount edited**

*RQ3: Influence of visualization type*

To compare among the three visualization types on first impressions of work quality (testing H3a and H3b), we conducted a one-way ANOVA comparing the three visualizations on first impressions of worker quality. There was no significant main effect of visualization type on first impressions of worker quality ( $F(2,216)=1.53, p=.21$ ). However, planned contrasts between the table and the two visual summary types of visualizations (graph + quadrant) revealed that the table (aka detailed format) led to more positive first impressions of worker quality than the two summary conditions ( $F(1,213)=10.93, p<.001$ ). This lent support to H3b, which predicted that more detail would lead to more positive attitudes.

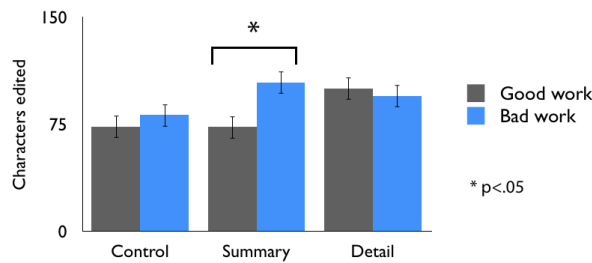
In order to see how the visualization of history affected final impressions and editing behaviors, we once again conducted paired t-tests for each visualization type on final impressions and editing behaviors after exposure to either good or bad work. For the analyses conducted, the graph and quadrant conditions were combined and we refer to them collectively as the “summary” conditions.

The positive first impressions induced by the detailed format (table) seemed to persist and remained immune to further experience with work quality. As shown in Figure 6, participants in the table (detail) condition had equally high final impressions of the worker’s quality, regardless of whether they saw examples of good or bad work ( $t[71]=1.17, p=.24$ ). This did not occur in the control condition ( $t[63]=2.49, p=.01$ ) or the summary conditions ( $t[144]=3.38, p<.001$ ).



**Figure 6. Effects of history visualization and work quality on final impressions of worker**

The visualization types also had different effects depending on whether they showed good or bad activity history. As Figure 7 indicates, only participants who had viewed work history in a summary format exhibited a significant difference in editing behaviors ( $t[144]=-4.26, p<.001$ ). Compared to the control ( $t[63]=.46, p=.46$ ) or table ( $t[71]=.45, p=.65$ ) conditions, they fixed significantly more bad work than good work, thus suggesting that they were more sensitive to fixing work in accordance with its actual quality.



**Figure 7. Effects of history visualization and work quality on editing behaviors**

**DISCUSSION**

**Implications for theory**

In conclusion, we found that positive first impressions based on a “good” work history engendered a positivity effect among participants in that condition. This made them more positively rate the quality of the worker, but at the same time made them neglect to fix more of the work, especially when it was needed. In contrast, a negative first impression seemed to make participants more sensitive to fixing bad work (but did not make them unduly critical towards good work.)

This result is somewhat surprising, since prior research on impression formation has suggested that negative information is typically more enduring than positive information [16]. If this was the case, we would not have seen a significant difference in editing behaviors between the two “bad history” conditions. However, our results are

in line with related recent work by Carr & Walther [2], which also saw lack of support for the negativity effect in the context of social media information in a hiring context.

While most evidence of the negativity bias comes from direct interpersonal evaluations online or in the real world, it could be that negative information generated by others (in our case, by a previous editor’s assessment) does not carry the same weight in informing impressions. For example, when users know little about the expertise or qualification of a previous rater, they may be less likely to trust past assessments [14].

There may be various explanations for the lack of negativity effect that we observed that are related to the online peer review task and setting. One potential mechanism driving the persistence of negative information is that it is more novel and memorable and also as seen as more non-normative [8]. The negativity bias is expected to be reversed in situations where there is an expectation of negative behavior as the norm. This may have been the case in our task, where participants were primed to look out for work to correct. Additionally, the positivity bias is most clearly observed in neutral situations where the target of evaluation is relatively novel and does not directly influence the observer during the process of evaluation [9].

**Implications for design**

Differences in behaviors and attitudes between different visualizations of activity history suggest that design choices about how much information to provide and how difficult it may be to fully process have the potential to influence work outcomes. One reason why the summary conditions may have led to differential editing behaviors based on the work could be that their designs featured color coding (using a green for good and red for bad) paradigm that made it easier to visually assess the overall work quality in a way that was not present in the table. Adding color to the table in a similar way could potentially encourage more editing of the work.

There could be other ways of enhancing a detailed work history to encourage more editing behaviors as well. For example, the system could insert artificial and fictitious bad history in cases where a worker might have little to no prior work history in order to induce more sensitivity and attention to fixing their work.

However, one caveat and tradeoff with doing this is that improved editing performance could come at the expense of more negative attitudes towards the worker. This could pose a problem in more collaborative situations with greater interactions between workers (e.g. in Wikipedia or software development). The role of task factors may also play a role in terms of the most desirable information to highlight about individuals.

In our task, which was decoupled and anonymized, participants had little expectation of interacting with the person whose work they were fixing. As a result, in this

type of situation it may be fine to highlight problems with their work in order to ensure more accurate editing. On the other hand, in a context where future interaction is expected, interpersonal attitudes and impressions of quality may play a bigger role in terms of outcomes to promote. Future work can address alternative design decisions and further explore their attitudinal and behavioral effects in a variety of collaborative task settings.

### CONCLUSION

Overall, our work provides some initial indications that observers are able to form fairly accurate impressions of an individual's past work history, but that both detail and valence play a role in the degree to which these impressions persist in the face of disconfirming evidence.

This work provides initial insights for designers of peer production systems about how various design parameters might influence both interpersonal attitudes and work evaluation behaviors (sometimes in different ways).

Given the increase in transparency of individuals' actions in online work contexts, there is great potential for leveraging this information to jump-start work relationships or to help recommend people for various tasks. However, our results suggest that not only *what* is presented but *how* it is shown can produce differing effects.

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