Conflict of Interest Mitigation Procedures May Have Little

Influence on the Perceived Procedural Fairness of Risk Research

Abstract

Two between-subject experiments explored perceived conflict of interest (COI)—operationalized as perceived procedural fairness—in a hypothetical public-private research partnership to study the health risks of trans fats. Perceived fairness was measured as subjects' perceptions that health researchers would be willing to listen to a range of voices and minimize bias (i.e., conflict of interest) in the context of a research project. Experiment 1 (n = 1,263) randomly assigned research subjects to a partnership that included (a) a combination of an industry partner, a university partner, and a non-governmental organization (NGO) partner and (b) one of three processes aimed at mitigating the potential for COI to harm the quality of the research. The procedures included an arm's-length process meant to keep the university-based research team from being influenced by the other partners; an independent advisory board to oversee the project; and a commitment to making all data and analyses openly available. The results suggest that having an industry partner has substantial negative effects on perceived fairness and that the benefit of employing a single COI-mitigation process may be relatively small. Experiment 2 (n = 1,076) assessed a partnership of (a) a university and either an NGO or industry partner and (b) zero, one, two, or three of the three COI-mitigation procedures. Results suggest there is little value in combining COI-mitigation procedures. The study has implications for those who aim to foster confidence in scientific research projects whose completion may require, or at least greatly benefit from, industry funding.

Key words

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1. **INTRODUCTION**

While the federal government funded most US research into the 1970s,[1] companies now financially support about two thirds of US research and development. As the percentage of public universities' operating budgets that comes from public funding continues to decrease, administrators expect faculty to become more entrepreneurial in seeking external funding. Indeed, university scientists are increasingly entering into public-private partnerships to support their research.[2-4] Yet, accepting industry funding to support their research may reduce public confidence in scientists' work and erode the perceived validity of their research findings.[5, 6] Such erosion of support for research may mean less opportunity for research to make a positive impact on society.

The current study therefore examines the extent to which communicating about procedures designed to mitigate perceived conflict of interest (COI) might reduce some of the negative perceptions that industry funding may foster. We understand COIs as situations where a person or group could improperly benefit from decisions for which they are responsible. These benefits might be financial, social, or some combination of the two.[7-9] The US Institute of Medicine defines conflicts of interest as "circumstances that create a risk that professional judgments or actions regarding a primary interest will be unduly influenced by a secondary interest."[10, p. 6] Primary interests might be protection of research integrity, students, and patients, while secondary interests could include personal and professional concerns.

The purpose of the current study is not to find ways to trick people into accepting poor-quality research that nefarious industry funders have tainted. Our research is based on an

underlying belief that it may be possible for scientists to conduct high-quality research with industry funding when researchers use appropriate safeguards. Also, if the current research provides evidence that communicating about conflict of interest mitigation procedures can limit negative perceptions about that research, then we will also provide evidence that critics of industry research may be able to effectively critique industry research by focusing on the quality of conflict of interest mitigation processes. The current research should therefore be understood as an effort to highlight the potential value of robust, well-communicated conflict of interest mitigation processes as means to maintain support for science. While confidence in science has remained relatively high and stable, other institutions (including medicine) have seen declines in confidence over time[11], and those involved in science should not take past confidence as a guarantee of future confidence.

Our next section provides an overview of the scholarship upon which our study builds. We draw primarily from social psychological theory in applying the concept of procedural fairness to examine COIs in a risk context. We then present the design and results of two experiments aimed at assessing the potential effectiveness of communicating about procedures associated with a hypothetical research collaboration. The first experiment investigates the efficacy of procedures individually, while the second one examines the effectiveness of combinations of procedures.

2. LITERATURE REVIEW

2.1 Fairness perceptions and conflict of interest perceptions

The current study builds upon the scholarly literature on procedural justice as fairness[12] and attempts to adapt this body of research to the study of risk communication.[13-16] The research should also be understood as an argument that the fairness literature could be seen as a way to understand why conflict of interest may matter to non-experts asked to make judgements about

the quality of scientific research. A recent experimental study[6] found that including an industry

partner in a research collaboration reduced the perceived fairness of the research and the extent

to which subjects believe that the research should be used in decision-making. A qualitative

component of that same study found that a nontrivial percentage of subjects believe that the

industry partner would find a way to influence the research no matter which other partners were

included. To extend that recent study, we too maintain that partner selection represents one

procedural choice that researchers may use to manage and communicate research integrity and

independence. Yet, here we seek to examine whether additional processes to mitigate conflict of

interest-related might affect fairness perceptions.

   The concept of procedural justice as fairness is useful to the study of conflict of interest.

Fairness research represents a well-established[12] body of literature that seeks to understand how

perceptions of decision-making processes shape peoples' willingness to accept decisions as

legitimate, whether or not they agree with the valence of the decision.[17] In general, as described

in more detail below, the research suggests that people are more likely to perceive outcomes as

legitimate when decisions are reached by objective, fair procedures and executed by respectful

and honest decision makers.[18-20] Consistent with this idea, conflict of interest is partly a problem

because of the potential that decision-makers may be acting in the interest of undisclosed or

private motives, thus failing to respect the autonomy of people who they may affect through their

choices. Beyond the risk context, empirical evidence has shown fair process effects in the

context of organizational (i.e., workplace),[21, 22] political,[23] and health [24] issues. However, only

limited efforts have focused on risk-related conflicts of interest.[8, 6] The current study thus

primarily seeks to advance procedural justice theory by testing the degree to which procedural

justice concepts can be readily adapted to such research.

The progression of fairness research highlights why the concept may help in the study of conflict of interest perceptions. The focus of procedural fairness research began as a critique of the idea that people mainly care about the degree to which they receive a fair distribution (i.e., distributive fairness) of outcomes such as salary. Initial research showed that people do not just care about outcomes. They also seem to care about the degree to which they had a voice in the processes that lead to those outcomes, even in cases where they do not get the outcome they wanted.[25, 22] We see this as similar to the idea that people may be able to accept research that is produced in the context of a potential conflict if they see the process resulting in the production of the research as fair. As is argued below, procedurally fair research would include research conducted in a way that is transparent and thus open to fulsome and public critique. Conceptual work presented by Leventhal[26] hypothesized that people infer fairness from a variety of related judgments, including the degree to which a decision-makers appear to: (a) suppress their own bias through some type of safe-guard; (b) provide those affected by a decision with accurate information; (c) consistently apply rules across persons and over time; (d) ensure that those affected are heard; (e) ensure that decisions are correctable; and (f) ensure that decisions are ethical.[26, 27] Tyler[28] similarly wrote that perceived procedural fairness can best be understood as a function of the degree to which someone sees a decision-maker as neutral or unbiased, having good intentions, and respectful of others' rights. From a measurement perspective, as the study of fairness progressed, arguments were made that it may make sense to differentiate procedural fairness as perceived voice from interpersonal fairness as politeness and respect. It may also sometimes make sense to differentiate informational fairness as perceived access to relevant information.[29, 12, 30] For the current study, however, a single-dimension measure of procedural fairness adapted from Leventhal[27] and more recent past work[6] is used. This use is

based on the argument that the procedures we used in the experiments might be expected to affect multiple sub-dimensions of fairness perceptions simultaneously but that, at present, we do not seek to understand these more specific effects. This is consistent with several past studies and the argument that, in practice, it is often difficult to differentiate non-outcome fairness dimensions.[6, 31-33]

While not directly tested here, it may also be useful to recognize that both theory[34] and empirical research[35, 34] suggest that fairness largely matters because it represents a heuristic cue that people can use in situations where there is no clear 'correct' outcome. This means, for example, that people are unlikely to draw on fairness process judgements when assessing decision-making for which the individual sees a clear, moral answer.[36] For example, no procedure is likely going to make a vehement anti-abortion activist see a pro-abortion decision as legitimate.[37] The idea of fairness as a heuristic cue is important in risk communication contexts such as studied here because most people are likely unable to analyze the quality of specific research. Instead, they are likely to look for cues such as conflicted interests that might help them assess whether they should accept the work. Relatedly, although not tested here, there is also evidence that fair process effects are most likely in situations where the decision-maker is perceived as being part of one's own group,[38] although fair procedures may also lead to perceptions of shared identity.[39, 40]

2.2 Conflict of interest mitigation processes

Given our desire to assess whether messages focused on quality procedure can be used to shape conflict of interest perceptions (measured as procedural fairness perceptions), the current research chose three, seemingly common potential mitigation processes to assess. The procedures included an arm's-length process meant to keep the university-based research team

from being influenced by the other partners; an independent advisory board process to oversee

the project; and a process involving a commitment to making all data and analyses openly

available. Each process is described, in turn. These three processes were selected by the

multidisciplinary research team based on their experience in the areas of risk communication,

history of science and technology, research ethics, and food science.

2.2.1 Keeping funders at "arm's length" to mitigate conflicts of interest

One type of process that the current study seeks to assess as an example of a conflict of

interest mitigation procedure is an explicit, public agreement to keep research funders at "arm's

length" from day-to-day research. The idea of promising to keep funders at a distance suggests

the fairness principle of bias suppression[26] by distancing stakeholders with vested interests from

decision processes. Specifically, arm's-length processes seek to ensure researchers' autonomy by

keeping control over research oversight, implementation, and reporting out of the hands of

funders or other potential actors with vested interests.[41] Some research shows that arm's-length

relationships are less likely to produce biases in favor of powerful stakeholders such as funding

agencies.[42] A standard way to establish an arm's-length process is to have a contractual

arrangement that lays out criteria meant to protect the independence of researchers from other

stakeholders.[43, 42]

2.2.2 Using external advisory boards to mitigate conflicts of interest

The use of external advisory boards with members from across key societal institutions is

a second type of process that could be used to mitigate potential conflicts of interest. Such boards

are consistent with the representativeness principle of procedural justice described by

Leventhal[26] inasmuch as they provide an opportunity for different stakeholders who are affected

by the research[44] to oversee decisions and have a direct voice with researchers. For

representativeness to be procedurally fair, stakeholders should be treated similarly and have

similar opportunity to express concerns.[45, 44, 46] One past study on conflict of interest showed

that the perceived procedural justice of those who attend the advisory committee meetings of the

Food and Drug Administration (FDA) (that include researchers, scientists, and professionals

from the industry and government) is positively associated with their satisfaction with the

meetings and acceptance of outcomes.[8]

2.2.3 Using transparency to mitigate conflicts of interest

The third conflict of interest mitigation process assessed in the current set of experiments

is a commitment to transparency through the open-sharing of data and analyses.[46, 45] In essence,

transparency represents "the process of making public the decisions or actions that were

previously made out of the public eye."[45 page # for direct quote?] In the context of research

partnerships, the hope is that disclosure can enable external parties to scrutinize other

stakeholders' potential roles and responsibilities including the design, data collection, data

analysis, sponsorship of research, and reporting of findings.[45-48] Faced with such disclosure, it

might also be hoped that stakeholders would refrain from making decisions that might cast the

research in a negative light, although the empirical evidence for this effect is not convincing at

present.[49]

2.3 Summary and Hypotheses

To summarize, we believe that it makes sense to study the potential effect of using

several different conflict of interest mitigation processes using concepts and measurement from

the research on procedural justice as fairness. Specifically, we are interested in assessing the

degree to which hearing about conflict of interest mitigation processes might lead people to see

collaborations that include industry as likely to be fair. To test this, we asked people about

research partnerships that did and did not include an industry partner as well as research that included one of the conflict of interest mitigation procedures above (experiment 1) or multiple versions of these experiments (experiment 2). Each of our specific hypotheses and research questions is detailed, in turn.

Our first hypothesis is based on past research, which strongly suggests that we should expect that the inclusion of a private sector actor will have negative effects on perceived fairness of the research:[6]

H1: Respondents will perceive a research partnership as less likely to be procedurally fair when the research team includes an industry partner than when such a partner is not included.

Previous research was less clear about whether having multiple non-industry partners might mitigate negative effects from the industry partner, so this is an ongoing research question:

RQ1: Will respondents see a research partnership that includes industry partners as more likely to be procedurally fair when both a university and a NGO partner are included in the partnership compared to when just one non-industry partner is included?

The more important and novel issue is the role of COI-mitigation procedures on fairness perceptions. Our expectation for the current research is that:

H2: Respondents will perceive a research partnership as more likely to be procedurally fair when the research team commits to a procedure that would seek to mitigate any potential conflicts of interest than when no such procedure is included.

The three types of procedures addressed in experiment 1 include: (H2a) an "arm's-length" process to manage conflict of interest is included in a research partnership description, (H2b) an "independent advisory board" process to manage conflict of interest is included in a research

partnership description; and (H2c) a "transparency" process to manage conflict of interest is included in a research partnership description.

Both H1 and H2 will be assessed in both experiment 1 and 2, whereas RQ1 is only relevant to experiment 1. A third hypothesis will be assessed in experiment 2 only. This hypothesis involves testing whether it should be expected that multiple COI-mitigation procedures might be more effective than a single procedure, although no specific combination of procedures is anticipated to be more effective than any other combination.

> H3: Respondents will perceive a research partnership as more likely to be procedurally
> fair when the research team commits to using a combination of procedures that would
> seek to mitigate any potential conflicts of interest in comparison to a partnership that uses
> either no procedure or a single procedure.

A final research question is also asked because it seems possible that the effect of conflict of interest mitigation procedures may be different for different sets of partners. It is not clear, however, whether having only non-industry partners will make procedures more or less impactful. A research question is therefore posed:

> RQ2: Do the effects of conflict of interest mitigation procedures depend on the partners
> involved in the research collaboration?

Both experiments reported below use the issue of trans fat (or partially hydrogenated oil) in food based on a judgement call that the issue represented the type of topic of potential research where there was both substantial public and industry interest[50, 51] but where there seemed to be little political polarization. We also wanted to focus on a food topic because of professional interest. As of 2006, the United States' Food and Drug Administration required food manufacturers to report the amount of trans fat on standardized product labels and being

removed from product through 2018.[52] Food manufacturers, in particular, used trans fats because of their shelf life and the texture they gave to food. Many other countries have almost imposed limits or bans on trans fat. We have no specific reason to believe that research using similarly un-politicized topics would produce substantially different results but we recognize this as an area for additional research. We would expect weaker results from a politicized issue given past findings related to motivated reasoning[53] or fairness in the context of issues where respondents have strong moral concerns,[54] and thus tried to avoid such topics here.

3. EXPERIMENT 1

3.1 Methods

The first experiment was an initial assessment of the effect of three different procedures as well as the degree to which how such effects might vary based on the composition of the research partnership. Experiment 1 (N=XXXX) employed a partial factorial design with two factors: partnership composition (four categories: university and NGO; university and company; company and NGO; company, university, and NGO) (H1) by COI-mitigation procedure (four categories: none; an arm's-length process; an independent advisory board process; and a transparency process) (H2a-c). The study was not a full factorial design, since it did not include situations where there was a no actor or only a single actor in the research partnership. Subjects were randomly assigned to one of sixteen experimental conditions containing one of the four partnership composition categories and one of the four COI-mitigation procedure categories. Appendix A contains the stimulus text for this first experiment.

Subjects read a brief vignette asking them to consider a research partnership that was being created to study trans-fat risks. The vignette then identified and briefly described the partners. The vignette also explicitly stated that critics had complained about past research

results because of COIs and that a procedure was therefore being put in place to "reduce the

potential" COI and "maintain the integrity of the research findings." The vignette then either

ended with no additional information or described one of the three COI-mitigation procedures

that the partnership was employing: an arm's-length process (H2a); an independent advisory

board process (H2b); and a transparency process (H2c).

In general, we treat the "university and NGO" partnership with no procedure as the

reference group or control condition. Consistent with previous research and based on pretests

showing that these organizations, compared to alternatives, received relatively high positive

ratings and low negative ratings,[6] we used Purdue University as the university partner, the

Union of Concerned Scientists as the NGO, and Kellogg's—a large, multi-national U.S.-based

food company that makes a range of consumer products under various brands—as the company.

To ensure that subjects remembered the partnership members throughout the experiment, the

combination of partners in their respective experimental condition was included in the

introductory statement accompanying key sections of questions. Further, comprehension check

questions at the end of the experiment assessed whether or not subjects could correctly identify

the composition of their assigned partnership and the type of COI-mitigation procedure

employed. Subjects who gave an incorrect answer to either comprehension check question were

excluded from the analyses.

Following the stimulus material that included the partnership and COI-mitigation

process, subjects answered a series of questions related to fairness perceptions, a direct

measurement of perceived COI, various measures of related attitudes and socio-economic status,

as well the aforementioned comprehension checks. The primary outcome variable discussed here

is perceived procedural fairness of the planned research. This was measured using responses to

six statements that combine concepts from the literatures on "procedural justice" as bias control

(questions 1-4, below) and voice (question 5-6).[6, 30] The question on "best interests" (question

5) is somewhat unique to such measures but was used based on the logic that it should capture

the idea of whether or not the respondent thinks that the relevant decision-makers are taking

others' perspectives into account. All questions were measured using 7-point "strongly disagree"

= 1 to "strongly agree" = 7 scale and averaged together ($M = 4.81$, $SD = 1.38$, Cronbach's *alpha*

= .92). The six statements included:

1. The research partnership will draw on the best available evidence ($M = 5.11$, $SD = 1.52$);

2. The research partnership will work hard to avoid biasing their results ($M = 4.92$, $SD = 1.62$);

3. The research partnership will slant their research to favor industry needs

    ($M = 4.39$, $SD = 1.83$) (reverse coded);

4. The research partnership will hide important findings if the results do not support its

    members' interests ($M = 4.61$, $SD = 1.81$) (reverse coded);

5. The research partnership will keep the best interests of consumers in mind

    ($M = 4.67$, $SD = 1.64$); and

6. The research partners will listen to each other's views ($M = 5.20$, $SD = 1.39$).

    Exploratory factor analysis using maximum likelihood estimation and varimax rotation

suggested that these six questions account for 66% of the variance of a single latent construct.

Past research argued that fairness perceptions mediated the relationship between stimulus and

perceived research legitimacy. The current study did not specifically test the mediation question

but the fairness measure used here was highly correlated ($r = .74$, $p < .00$, n = 1,244) with the

same three item measure of legitimacy ($M = 5.56$, $SD = 1.42$) used in that study.[6] The fairness

measure was also negatively correlated ($r = .72$, $p < .00$, n = 1,244) with a direct measure of

perceived conflict of interest that was measured using a 7-point bipolar scale anchored by "this partnership would create NO conflict of interest" (1) and "this partnership would create a COMPLETE conflict of interest" (7)($M = 3.78$, $SD = 1.94$). While these specific questions were drawn from the justice literature and focus on perceptions of expected behavior, one might also expect that the measures used would be highly correlated with global measures of concepts such as "credibility" inasmuch as such measures often include reference to bias, accuracy, fairness, and openness trustworthiness,[55] as well as the "integrity" sub-dimension of trustworthiness which also includes concepts related to consistency, fairness, and strong values.[56] While clearly overlapping literatures, a key difference between fairness and trust research is that trust questions typically focus on existing perceptions of a group whereas the fairness literature focuses on perceptions of actors in the context of decision-making processes. In this regard, one would expect fair process to support the development of trust and one might also expect that people would be less likely to see procedures as fair if implemented by groups deemed untrustworthy.[57]

We conducted both of our experiments using Qualtrics to present the stimulus and questions to subjects recruited via Amazon Mechanical Turk (AMT). AMT uses crowdsourcing to perform "human intelligence tasks" (HITs). AMT has emerged as a practical way for recruiting a large number of participants from a reasonably wide cross-section of individuals for online experiments[58] or the testing of measurement instruments[59] in a wide range of social science disciplines.[60, 61] To solicit a broad cross-section of research subjects and minimize self-selection by AMT workers highly interested in food issues, we advertised a HIT titled "Industry Views Survey." We limited participation to adults residing in the United States. The primary authors' Institutional Review Board (IRB) approved the research (Approval number #i048105

with research categorized as "exempt"). The first page of the questionnaire included the approved consent statement, and respondents indicated consent by continuing with the questionnaire.

For experiment 1, the #### respondents who correctly answered the comprehension check questions were 53% female and 81% white with no significant differences by overall condition for either sex (*Contingency coefficient* = .124, *p* = .22) or race (*Contingency coefficient* = .12, *p* = .31). Average age in years was 38.75 (*SD* = 12.41) with no significant difference by condition according to a one-way ANOVA (*F*[15, 1,208] = .38, *p* = .99). Similarly, education measured using a four-point scale where high school or less = 1, college associate's degree = 2, university bachelor's degree = 3, and graduate degree = 4, was 2.47 (SD = 1.04) suggesting an average education level between college and university. Again, and consistent with random assignment, there was no meaningful difference in education by condition ANOVA (*F*[15, 1,209] = .75, *p* = .74).

3.2 Experiment 1 Results

Mean fairness perceptions by condition are reported in figure 1 and table A1 in Appendix B. Figure 1, which orders responses by mean, suggests that simply excluding the industry partner results in relatively higher fairness perceptions. It appears that the procedures at the low end of perceived procedural fairness are typically those for which there is an industry partner (H1) and no COI-mitigation process (H2). In the middle, appear to be partnerships with both Purdue and the UCS, along with Kellogg's (RQ1). However, the confidence intervals (and the formal post-hoc mean comparison in table A1 in Appendix B) suggest that any observed difference is not large enough to be significantly different, given the sample size.

A more formal test of the hypotheses using General Linear Model estimation (SPSS v23, Type III sum of squares) indicates the presence of meaningful differences consistent with both H1 and H2. Relevant statistical information is provided in table 1 and thus not repeated in the text. Specifically, the results highlight that, while inclusion of arm's length (H2a) and independent advisory board (H2b) processes were significant predictors of respondent fairness perceptions, the overall effect is dwarfed by the effect of the composition of the partnership (H1). The effect of a "transparency" process would be considered significant using a 1-sided test. Overall, the GLM model appears to explain about 12% of the overall variance in respondents' fairness perceptions.

For RQ1, examination of confidence intervals derived from the standard errors in table 1 suggests that there is likely little meaningful benefit to adding a second, non-industry partner to a partnership already involving an industry partner. Specifically, the 95% confidence interval for the GLM estimate for "all three partners" is $b = -1.12$ to $b = -.80$ and this slightly overlaps with the 95% confidence interval estimates for the "Kellogg's and UCS" partners ($b = -1.43$ and $b = 1.11$) and substantially overlaps with the 95% confidence interval estimates for the "Kellogg's and Purdue" partnership ($b = -1.18$ to $b = .86$).

An additional GLM model (appendix 1b) that includes separate estimates for the effect of the COI-mitigation procedures for each set of partners further highlights the importance of partner. This additional model shows that accounting for the interaction between partner and procedure adds little additional explanatory value (RQ2).

3.2 Experiment 1 Discussion

The results of this first study suggest that our respondents used the partners involved in a research collaboration (H1) as a primary variable underlying whether they expected the study

they were told about in the stimulus to be carried out in a fair way. Having multiple non-industry

partners did not meaningfully change fairness perceptions. The results further suggest that letting

people know that there is a process in place to mitigate procedures has only a limited potential to

mitigate potential concerns about the resulting research (H2). Yet, this first experiment considers

only the effect of single, stand-alone COI-mitigation process. Experiment 2 will examine

whether adding additional procedures might assuage subjects' potential worry about fairness.

This is ultimately important because past research suggests that such fairness perceptions would

be highly correlated with the degree to which they say the research is a legitimate body of

evidence on which to make personal and civic decisions.[6]

4. EXPERIMENT 2

4.1 Experiment 2 Methods

Experiment 2 (n = 1,076) also employed a partial factorial design with two factors:

partnership composition (two categories: university and NGO; university and company) (H1) by

COI-mitigation procedures (eight categories: none; an arm's-length process; an independent

advisory board process; a transparency process; an arm's-length process and an independent

advisory board process; an arm's-length process and a transparency process; an independent

advisory board process and a transparency process; and an arm's-length process, an independent

advisory board process, and a transparency process) (H2 and H3). Subjects were randomly

assigned to one of sixteen experimental conditions containing one of the two partnership

composition categories and one of the eight COI-mitigation procedure categories. Appendix C

contains the stimulus text for this second experiment.

Other than the partnership composition categories and COI-mitigation procedure

categories, the remainder of the experimental instrument was the same as was used in

Experiment 1. As before, subjects who gave an incorrect answer to either comprehension check question were excluded from the analyses. Again, the primary outcome variable is perceived procedural fairness, which was measured with the same six questions with the same 7-point "strongly disagree" = 1 to "strongly agree" = 7 scale. These were averaged together (M = 5.23, SD = 1.32, Cronbach's *alpha* = .91). The six statements were:

- The research partnership will draw on the best available evidence (M = 5.50, SD = 1.41);

- The research partnership will work hard to avoid biasing their results (M =5.38, SD = 1.55);

- The research partnership will slant their research to favor industry needs

  (M = 5.05, SD = 1.58) (reverse coded);

- The research partnership will hide important findings if the results do not support its

  members' interests (M = 4.94, SD = 1.82) (reverse coded);

- The research partnership will keep the best interests of consumers in mind

  (M =5.10, SD = 1.76); and

- The research partners will listen to each other's views (M = 5.39, SD = 1.39).

For experiment 2, similar to experiment 1, the XXXX subjects who correctly answered the comprehension check questions were 52% female and 82% white with no significant differences by overall condition for either sex (*Contingency coefficient* = .12, p = .43) or race (*Contingency coefficient* = .10, p = .78). Average age in years was 38.87 (SD = 12.29) with no significant difference by condition according to a one-way ANOVA (F[15, 1,054] = 1.01, p = .45). Similarly, education measured using a four-point scale where high school or less =1, college associate's degree = 2, university bachelor's degree = 3, and graduate degree = 4 was 2.48 (SD = 1.04), and there was no meaningful difference by condition ANOVA (F[15, 1,053] = .44, p = .97).

4.2 Experiment 2 Results

Mean fairness perceptions by condition are reported in figure 2 and table A2 in Appendix D. When it comes to fairness perceptions, as with experiment 1, it clearly helps not to have an industry partner (H1). The difference between having an industry partner and not having an industry partner amounted to about a full point on a 7-point scale.

In contrast, the value of COI-mitigation procedures appears to be limited (H2). As can be seen in the figure, the mean fairness scores for the university-NGO partnerships are all between 5.51 and 5.91 on a 7-point scale and the associated 95% confidence intervals of the means all overlap. These scores are also well above the scale midpoint, suggesting that respondents generally expected the research described in the stimulus to be conducted fairly. The mean fairness scores for the university-industry partnerships were lower and more varied. The means range from 4.45 to 5.20. In this case, given that the control condition resulted in the lowest absolute mean fairness score, the fact that some of the 95% confidence intervals do not overlap suggests at least some of the COI-mitigation procedures (or combination of procedures) had a positive effect on perceived research fairness (see also post-hoc mean comparisons in table A2 in Appendix D).

Multivariate analyses were done using only respondents assigned to the university-industry partnership because of the lack of variation within the mean fairness scores for the university-NGO conditions (RQ2). For the respondents assigned to university-industry partnership conditions, the General Linear Model estimates (Type III Sum of Squares) reported in table 2 (and not repeated in the text) indicate that two of the three procedures—an arm's-length process and a transparency process (H1)—may have resulted in relative increases to fairness perceptions. The "independent advisory board" condition, in contrast, did not seem to

provide any substantive increase to fairness perceptions when compared to the no-procedure reference group. Adding all three procedures (H3) also resulted in no substantive increase in fairness perceptions relative to the no-process condition. The overall variance in fairness perceptions explained by the COI-mitigation processes—about 2%—was very small.

An alternate model was also run that looked at the number of COI-mitigation procedures. This model (table 3) suggests that information about one process is better than no process information but that two or three processes are not better than one process. In other words, adding additional COI-mitigation processes beyond an initial process did not substantively improve fairness perceptions. This can be seen in the fact that parameter estimates for two and three procedures were not significant when the reference category is a single COI-mitigation process.

4.3 Experiment 2 Discussion

Similar to experiment 1, the results suggest a meaningful effect of having an industry partner on whether or not someone sees a research project as likely to be fair (H1). In contrast, the effect of COI-mitigation procedures appears to be somewhat modest. More importantly, experiment 2 showed that including additional procedures, beyond an initial one, was unlikely to enhance perceptions of research fairness. The fact that being in the "independent advisory board" condition was associated with somewhat higher fairness perceptions in experiment 1 but not experiment 2 can be understood simply by recalling that both estimates have associated confidence intervals. The fact that "transparency" was significant in experiment 2 but not experiment 1 can be similarly understood. It is therefore likely unwise to say that there is evidence in this research that one COI-mitigation procedure is better than another.

5. OVERALL DISCUSSION

The current research, building on past work,[6, 8] continues to show that partners are important drivers of how people make sense of whether research is likely to be carried out appropriately. Although COI-mitigation procedures may help limit some negative effects of having an industry partner, no evidence yet suggests that the impact is likely to be substantial. This can be seen both in looking at the relative means and at the size of the coefficients in associated models. It can also be seen in the fact that respondents who were told about a research collaboration with multiple COI-mitigation procedures were not more likely to expect the collaborators to conduct their research in a procedurally fair manner than were respective counterparts told about a collaboration involving a single procedure. The small amount of variance explained —just 2%—by the models looking at the effect of having multiple procedures (tables 2 and 3) further points to the limited value of procedures in mitigating the negative impact of having an industry collaborator.

But all is not lost for those who believe it should be possible to enter into research partnerships with industry actors to conduct research that the public ultimately sees as valid. The research suggests there is some limited value to having at least one COI-mitigation procedure. Also, it is important to remember that the experiments reported here focused only on a hypothetical partnership in the context a single potential health risk. The stimuli used also only included a relatively small amount of content related to COI-mitigation processes. Future research may therefore need to consider stronger stimuli aimed at highlighting the effectiveness of COI-mitigation procedures as well as a research collaboration's commitment to those procedures. Evidence about a research team's pro-social motivation (i.e., warmth or caring) and competence (i.e., ability to conduct quality research in the face of challenges) may also matter both on their own[62] and, perhaps, as a moderator of procedural information. In this regard, it

seems possible that people would be more likely to attend to fairness cues in cases of higher trust in the decision-maker. Also, inasmuch as the current research was done using an AMT (i.e., availability) sample, it will be important to test the impact of COI-mitigation procedures with more representative samples and, where possible, using real world cases. Issues beyond trans fats should also be studied.

On the other hand, our evidence suggests that finding COI-mitigation processes that most people interpret as meaningful is likely to prove difficult. For example, it might be expected that many people evaluating a partnership in the real world might be motivated to judge the processes themselves based on pre-existing views about the specific types of partners involved. (i.e., they may engage in motivated reasoning).[53] For example, someone with a strong anti-corporate or anti-academic perspective may interpret any additional procedural information through their existing anti-industry or anti-academic perspective. Nevertheless, the expectation is that enough people may have enough of an open mind that it remains worth finding ways to ensure that observers accept quality research and rightfully question research where appropriate processes are not in place. This means both identifying meaningful COI-mitigation processes and finding ways to communicate that these processes are being implemented in meaningful ways. This search will likely need to include both contemporary[63-65] and historical[66, 67] investigations regarding the practices that have been used and/or are being used. The search also likely requires ongoing consideration by policy experts and ethicists as to the degree to which potential processes have a meaningful potential to substantially shape the practice of research involving partners with potential conflicts.

More broadly, people continue to report relatively high confidence in scientists and generally support research[11, 68], but the research community should not assume this situation

will persist indefinitely. Those who value seeing science play an important role in policy and

personal decisions related to risk thus need to think strategically about how to help those

involved in research communicate in ways that ensure support.[69] This likely includes an

emphasis on fostering stakeholder beliefs in outcomes related to concepts such as trust and

fairness, such is suggested in the current work.

Tables and Figures (~1,250 words)
Figure 1. Perceived procedural fairness by partner composition and COI-mitigation process for Experiment 1*
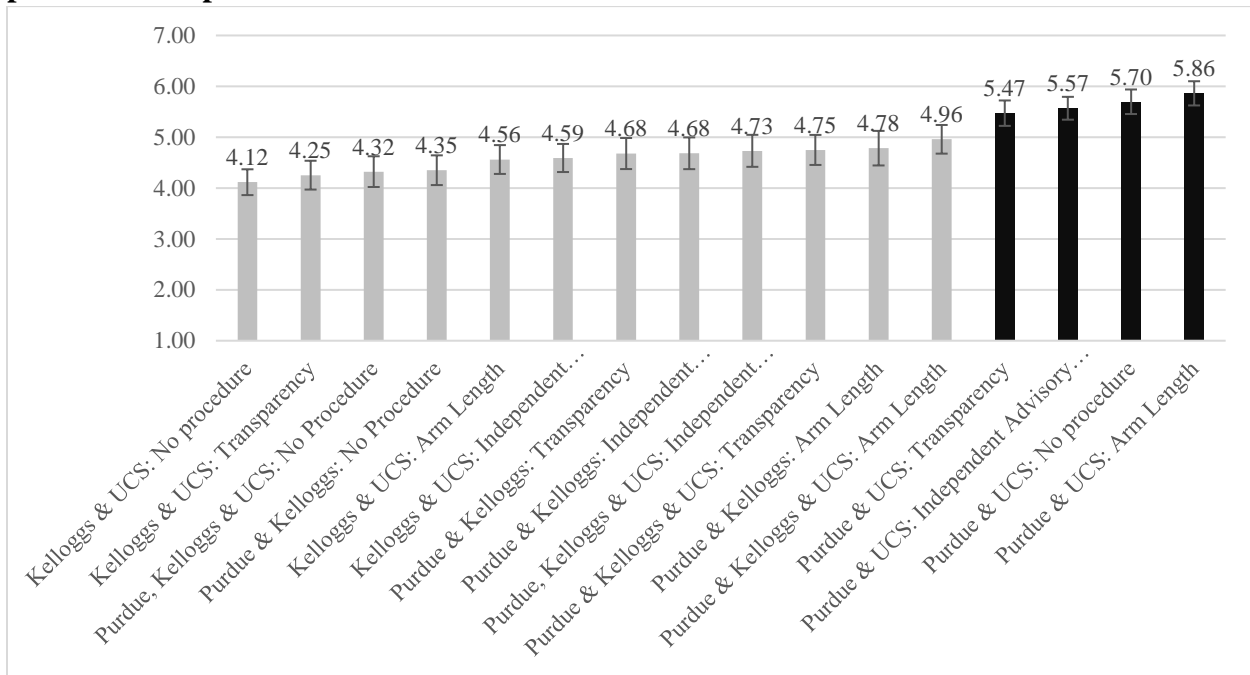
Notes: Light grey denotes a partnership that includes Kellogg's, and black denotes partnerships that do not include Kellogg's. Error bars represent 95% confidence intervals.

Figure 2. Perceived fairness by partner and COI-mitigation process for Experiment 2
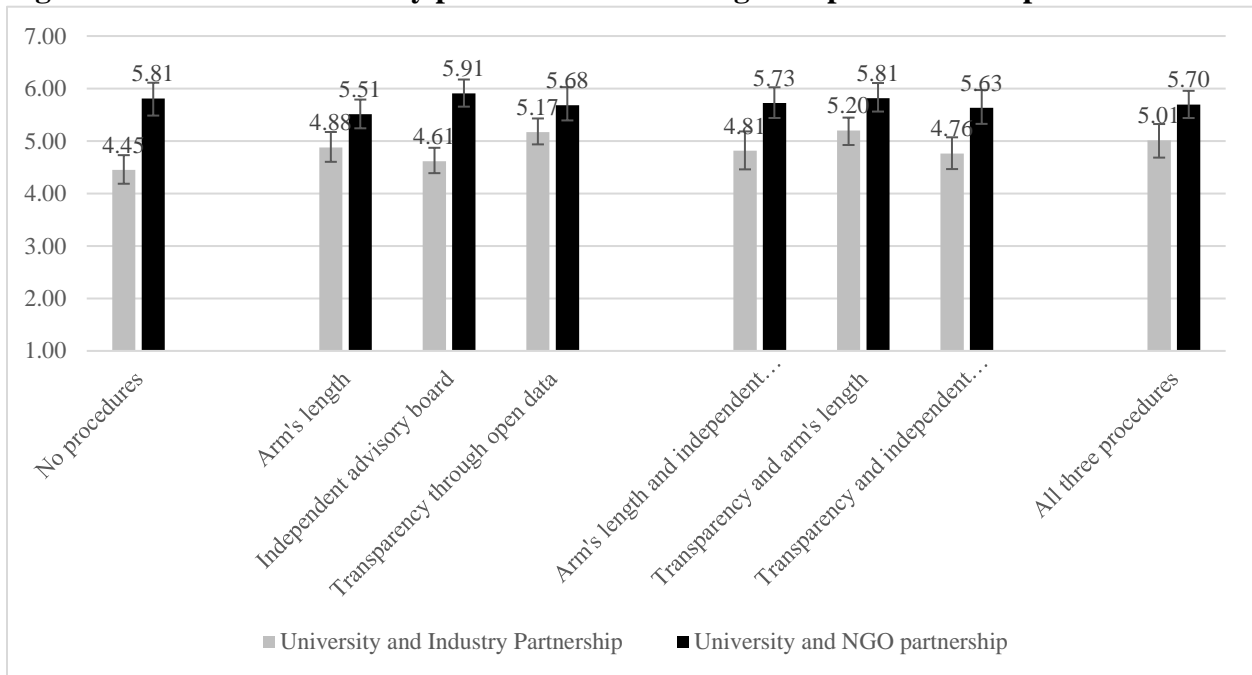
Notes: Light grey denotes a partnership that includes Kellogg's, and black denotes partnerships that do not include Kellogg's. Error bars represent 95% confidence intervals.

Table 1. GLM parameter estimates (unstandardized coefficients) and model summary for perceived procedural fairness (Experiment 1)

	B	SE	Sig.	95% CI: LB	95% CI: UB	part-eta^2
Intercept	5.43	0.10	.00	5.24	5.62	0.72
Arm's length	**0.42**	**0.10**	**.00**	**0.22**	**0.63**	**0.01**
Independent advisory board	**0.28**	**0.10**	**.01**	**0.08**	**0.47**	**0.01**
Transparency through open data	0.17	0.10	.10	-0.03	0.37	0.00
(Reference group is 'no procedure')						
All three partners	**-0.96**	**0.10**	**.00**	**-1.17**	**-0.76**	**0.06**
Kellogg's and UCS	**-1.27**	**0.10**	**.00**	**-1.47**	**-1.06**	**0.11**
Kellogg's and Purdue	**-1.02**	**0.10**	**.00**	**-1.23**	**-0.82**	**0.07**
(Reference group is Purdue and UCS)						
Adjusted-r^2	*0.13*					

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	part-eta^2
Corrected Model	314.580[a]	6	52.43	31.54	.00	0.13
Intercept	29415.82	1	29415.82	17697.63	.00	0.93
Procedure	**30.17**	**3**	**10.06**	**6.05**	**.00**	**0.01**
Partner	286.57	3	95.52	57.47	.00	0.12
Error	2087.64	1256	1.66			
Total	31670.94	1263				
Corrected Total	2402.22	1262				

Table 2. GLM parameter estimates (unstandardized) **and model summary for procedural fairness of participants assigned to the university-industry partnership only (Experiment 2)***

	B	SE	Sig.	95% CI: Low	95% CI: High	part-eta^2
Intercept	4.45	0.15	.00	4.15	4.75	.58
Arm's length	**0.43**	**0.21**	**.04**	**0.02**	**0.84**	**.01**
Independent advisory board	0.16	0.21	.43	-0.24	0.57	.00
Transparency through open data	**0.72**	**0.23**	**.00**	**0.28**	**1.17**	**.02**
Arm's length x Independent advisory board	-0.23	0.29	.43	-0.80	0.35	.00
Transparency x arm's length	-0.40	0.31	.20	-1.02	0.21	.00
Transparency x independent advisory board	**-0.57**	**0.31**	**.06**	**-1.17**	**0.03**	**.01**
Interaction of all three procedures	0.45	0.43	.30	-0.40	1.30	.00
Adjusted-r^2	*.02*					

(Reference group is 'no procedure')

	Type III Sum of Squares	df	Mean Square	F	Sig.	part-eta^2
Corrected Model	33.733^a	7	4.82	2.77	.01	.03
Intercept	14157.478	1	14157.48	8133.74	.00	.93
Arm's length	**7.723**	**1**	**7.72**	**4.44**	**.04**	**.01**
Independent advisory board	2.254	1	2.25	1.30	.26	.00
Transparency through open data	**18.103**	**1**	**18.10**	**10.40**	**.00**	**.02**
Arm's length and independent advisory board	.001	1	0.00	0.00	.98	.00
Transparency and arm's length	1.162	1	1.16	0.67	.41	.00
Transparency and independent advisory board	4.489	1	4.49	2.58	.11	.00
All three procedures	1.883	1	1.88	1.08	.30	.00
Error	1044.351	600	1.74			
Total	15360.694	608				
Corrected Total	1078.085	607				

Notes: *Research subjects assigned to the university-NGO partnership condition not included in the analysis because there was little variation between procedure conditions in this sub-sample.

Table 3. Experiment 2, alternate GLM model for procedural fairness focused the number of COI-mitigation procedures for participants assigned to the university-industry partnership only (H3)(Experiment 2)*

	B	SE	Sig.	95% CI: Low	95% CI: High	part-eta^2
Intercept	4.86	0.09	.00	4.69	5.03	0.84
0 COI-mitigation procedures	**-0.41**	**0.18**	**.02**	**-0.76**	**-0.06**	**0.01**
1 COI-mitigation procedures (reference group)						
2 COI-mitigation procedures	0.05	0.12	.68	-0.19	0.30	0.00
3 COI-mitigation procedures	0.15	0.17	.37	-0.18	0.49	0.00
Adjusted-r^2	*.01*					

	Type III Sum of Squares	df	Mean Square	F	Sig.	part-eta^2
Corrected Model	14.83[a]	3	4.94	2.81	.04	.01
Intercept	10608.60	1	10608.60	6026.41	.00	.91
Number of COI-mitigation procedures	**14.83**	**3**	**4.94**	**2.81**	**.04**	**.01**
Error	1063.25	604	1.76			
Total	15360.69	608				
Corrected Total	1078.08	607				

Notes: *Research subjects assigned to the university-NGO partnership condition not included in the analysis because there was little variation between procedure conditions in this sub-sample.

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Appendix A

Study 1 Stimulus

Our goal is to understand your views about a potential new cooperative research partnership aimed at studying the possible negative health impacts of low levels of trans fats in food.

This research will be funded and conducted by groups of researchers from:

[Respondents were randomly assigned to see various
combinations of partners in groups of two, or all three partners]

- Purdue University
- Kellogg's (a food company)
- The Union of Concerned Scientists (a non-governmental organization)

Recent research has shown that large quantities of trans fats are unhealthy. However, little is known about the effects of eating small amounts of trans fats. Those involved in food production sometimes use small amounts of trans fats to give food a softer texture. Some groups have raised health concerns about even these small amounts of trans fats.

This research would help decide whether trans fats should be used. It could mean that some foods would not be sold or would cost more because of the need to use different ingredients.

Critics have also complained that past research results related to trans fats may not be correct because of some researchers' conflicts of interest.

[Respondents then saw one of three options, or no procedure detail (control)]

[1] This partnership will therefore employ a procedure to reduce potential conflict of interest and maintain the integrity of its research findings. Briefly, the researchers will establish a contractual arrangement to keep the other partners at "arm's length" from the university scientists who will be performing the research. The university scientists will have sole control over all decisions about the design, interpretation, and publication of the study. [Arm's length condition]

[2] This partnership will therefore employ a procedure to reduce potential conflict of interest and maintain the integrity of its research findings. Briefly, the researchers will make all of their data and analyses openly available to other scientists and members of the public at the end of the study. This will enable scientists and others from outside the partnership to evaluate the study design and results provided by the researchers. [Transparency through open data condition]

[3] This partnership will therefore employ a procedure to reduce potential conflict of interest and maintain the integrity of its research findings. Briefly, the researchers will create an independent advisory board that includes members from government agencies, industry, non-governmental organizations, and other universities. The advisory board will provide guidance on the design, interpretation, and publication of the study. [Independent advisory board condition]

Appendix B

Table A1. Descriptive statistics for perceived Fairness (Experiment 1)

	Mean	SD	SE	95% CI: Low	95% CI: High	Sig. Dif.	N
Kellogg's & UCS: No procedure	4.12	1.17	0.13	3.86	4.37	a	82
Kellogg's & UCS: Transparency	4.25	1.31	0.14	3.97	4.54	ab	82
Purdue, Kellogg's & UCS: No Procedure	4.32	1.39	0.15	4.02	4.63	ab	82
Purdue & Kellogg's: No Procedure	4.35	1.43	0.15	4.06	4.65	ab	92
Kellogg's & UCS: Arm Length	4.56	1.30	0.14	4.27	4.85	ab	81
Kellogg's & UCS: Independent Advisory Board	4.59	1.26	0.14	4.31	4.87	ab	80
Purdue & Kellogg's: Transparency	4.68	1.40	0.16	4.37	4.99	ab	81
Purdue & Kellogg's: Independent Advisory Board	4.68	1.39	0.16	4.37	5.00	ab	76
Purdue, Kellogg's & UCS: Independent Advisory Board	4.73	1.47	0.16	4.41	5.05	ab	84
Purdue & Kellogg's & UCS: Transparency	4.75	1.26	0.15	4.45	5.05	ab	70
Purdue & Kellogg's: Arm Length	4.78	1.54	0.17	4.44	5.13	abc	79
Purdue & Kellogg's & UCS: Arm Length	4.96	1.23	0.14	4.67	5.25	bcd	73
Purdue & UCS: Transparency	5.47	1.13	0.13	5.22	5.73	cde	79
Purdue & UCS: Independent Advisory Board	5.57	1.04	0.11	5.34	5.80	de	82
Purdue & UCS: No procedure	5.70	1.08	0.12	5.45	5.94	e	77
Purdue & UCS: Arm Length	5.86	0.96	0.12	5.62	6.11	e	63
Total	4.81		0.04	4.74	4.89		1263

Notes: Shared letter indicates a non-significant mean difference using a post-hoc Tukey test.

Appendix C

Study 2 Stimulus

Our goal is to understand your views about a potential new cooperative research partnership aimed at studying the possible negative health impacts of low levels of trans fats in food.

This research will be funded and conducted by groups of researchers from:

- Purdue University

    [Respondents were randomly assigned to see one of the two partners]

- the Union of Concerned Scientists (a non-governmental organization)
- Kellogg's (a food company)

Critics have, however, complained that past research results related to trans fats may not be correct because of some researchers' conflicts of interest.

[Respondents were shown three, two, or one of the procedures, or no procedure detail (control). Those who saw two procedures were randomly assigned the three possible combinations.]

This partnership will therefore employ THREE procedures to reduce potential conflict of interest and maintain the integrity of its research findings

First, the researchers will make all of their data and analyses openly available to other scientists and members of the public at the end of the study. This will enable scientists and others from outside the partnership to evaluate the study design and results provided by the researchers.

Second, the researchers will establish a contractual arrangement to keep the other partners at "arm's length" from the university scientists who will be performing the research. The university scientists will have sole control over all decisions about the design, interpretation, and publication of the study.

Third, the researchers will create an independent advisory board that includes members from government agencies, industry, non-governmental organizations, and other universities. The advisory board will provide guidance on the design, interpretation, and publication of the study.

As background, recent research has shown that large quantities of trans fats are unhealthy. However, little is known about the effects of eating small amounts of trans fats. Those involved in food production sometimes use small amounts of trans fats to give food a softer texture. Some groups have raised health concerns about even these small amounts of trans fats.

This research would help decide whether trans fats should be used. It could mean that some foods would not be sold or would cost more because of the need to use different ingredients.

Appendix D

Table A2. Descriptive statistics for perceived Fairness (Experiment 2)

| | Purdue and Kellogg's | | | | | | Purdue and UCS | | | | | |
	Mean	SD	SE	95% CI: Low	95% CI: High	n	Mean	SD	SE	95% CI: Low	95% CI: High	n
No procedures	4.45	1.32	0.15	4.14	4.75	74	5.81	1.19	0.14	5.52	6.10	68
Arm's length	4.88	1.36	0.14	4.59	5.16	90	5.51	1.16	0.15	5.21	5.81	60
Independent advisory board	4.61	1.27	0.14	4.34	4.88	87	5.91	1.00	0.13	5.64	6.17	58
Transparency through open data	5.17	1.38	0.17	4.82	5.52	63	5.68	1.09	0.13	5.42	5.95	68
Arm's length and independent advisory board	4.81	1.33	0.15	4.51	5.12	77	5.73	1.30	0.19	5.35	6.10	48
Transparency and arm's length	5.20	1.18	0.15	4.90	5.50	63	5.81	0.97	0.13	5.56	6.07	59
Transparency and independent advisory board	4.76	1.49	0.17	4.42	5.11	74	5.63	1.10	0.16	5.32	5.95	49
All three procedures	5.01	1.19	0.13	4.75	5.28	80	5.70	1.21	0.16	5.38	6.01	58