Ethical Reasoning with the 2016 Revised ASA Ethical Guidelines for Statistical Practice

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Abstract

Interest in the 2016 revised American Statistical Association (ASA) Ethical Guidelines for Statistical Practice is keen across the ASA membership and leadership, but as of the 2013-14 academic year, only 35% of US universities required any ethics content for even some of their students in statistics and biostatistics programs. The Guidelines are complex – as is statistical consulting – and the ASA Guidelines require both instruction and practice, particularly to prioritize its principles during statistical consultation. The last 15 years have also seen growing interest in "pro bono statistics" - volunteer statistical consulting as a social service. In the United States, two ASA-based organizations engage directly in pro bono statistics: Statistics Without Borders works with clients globally, while members of the Statistics in the Community (StatCom) Network work at the local and state levels.

In this paper, we discuss how to engage in ethical reasoning using the 2016 revised ASA Ethical Guidelines; examples arising from consulting (using actual experiences) are employed, although the examples are applicable or adaptable to any statistical work. The purpose is to demonstrate ethical reasoning *both* for instructors interested in adding this feature to consulting courses *and* for students or consultants who wish to build experience, and evidence of engagement, with the ASA Ethical Guidelines.

Key Words: Ethical reasoning; ethics education; ASA Ethical Guidelines; statistical consulting.

1. Introduction

Due in part to the emergence of big data, and of Statistics as a profession, the number of professionals who specialize in data analysis is growing exponentially across scientific domains and almost all industries for engaged in analysis, interpretation, and decision-making. Whenever data are analyzed, the American Statistical Association's Ethical Guidelines for Professional Practice (American Statistical Association, ASA, 2016 – see Appendix) articulate that quantitative scientists –whether or not they self-identify as "statisticians" – are obliged, and should recognize the obligation, to practice data and quantitative sciences responsibly and professionally.

The National Institutes of Health (NIH, 2009) describes "training in the responsible conduct of research" as an essential part of all federally funded training (although see Tractenberg, 2016-a, for important exemptions pertaining to big data applications), and they articulate a series of topics with which trainees should be/become familiar. Tractenberg (2013) and Tractenberg & FitzGerald (2015) have described the ways that training data analysts with the ASA Ethical Guidelines for Professional Practice meet or exceed the NIH requirements while also providing training in ethical reasoning that goes far beyond typical engagement with NIH topics.

Ethical reasoning is a learnable, improvable skill set (Tractenberg & FitzGerald, 2012), comprising the following knowledge, skills, and abilities (KSAs): the identification and assessment of one's prerequisite knowledge; recognition of a moral issue; identification of relevant decision-making frameworks; identification and evaluation of alternative actions; making & justifying a decision (about the moral issue that was recognized); and reflection on the decision (Santa Clara University (no date), http://www.scu.edu/ethics/; Tractenberg & FitzGerald, 2012; see also Kligyte et al., 2008, and Hollander & Arenberg, 2009). The ethical reasoning KSAs were derived from compendia of scholarly work reflecting ethical decision making (described in detail in Tractenberg & FitzGerald, 2012, and Tractenberg, 2016-b). That ethical reasoning is learnable and *improvable* implies that later in one's career an individual should be capable of more sophisticated reasoning than at the start; the current NIH type training paradigm instead functionally encourages static engagement with topics (Tractenberg, 2016-a) that can seem less relevant for data analysis and science (e.g., nonmaleficence, laboratory management, or obtaining consent; see Tractenberg, 2013) and that are not specifically structured to grow over the scientist's career (Tractenberg & FitzGerald, 2012).

The focus on learnability of the ethical reasoning KSAs explicitly entails that time and effort must be dedicated to learning and practicing these KSAs (Tractenberg, 2016-b; see also Tractenberg, 2016-c). Thus, in this paper we describe ethical reasoning for data analysts and data scientists that promote engagement and familiarity with the revised ASA Ethical Guidelines for Professional Practice (ASA, 2016). Importantly, we specify here that the ASA Ethical Guidelines are focused on *ethical* and not "moral" issues, which is a slight departure in the *language* but not the *intention* of the ethical reasoning KSAs; the emphasis on rational decision-making in the original (2012) formulation remains. In the tables and discussion that follow, we articulate the ethical reasoning KSAs (Tractenberg & FitzGerald, 2012) together with the ASA Ethical Guidelines, demonstrating their synergies for identifying and making justifiable decisions in the face of ethical challenges that can arise in any type of statistical consultation or collaboration.

In particular, "pro bono statistics" - volunteer statistical consulting as a social service - is becoming increasingly prevalent. In the United States, two ASA-based organizations engage directly in pro bono statistics: Statistics Without Borders works with clients globally (Gunaratna & Shapiro, 2014), while the student members of the Statistics in the Community (StatCom) Network work to support initiatives at the local and state levels (Gunaratna et al., 2006; Gunaratna et al., 2007). Additionally, volunteer consulting may also be a learning opportunity where statistics students volunteer to consult on research projects in, or for, their academic community. A common feature in all of these consulting contexts is that statistical expertise is extremely important to promote good science and evidence-informed decision-making; the volunteers seek to ensure that this important input is not missing from critical projects because of a client's lack of resources.

2. Methods

We have structured the integration of ethical reasoning using the 2016 ASA Ethical Guidelines to address and work through a variety of common challenges that can arise in statistical consulting and collaborative conditions. This focus on ethical *reasoning* promotes engagement in realistic decision-making, and not memorization, around the ASA Guideline Principles. With increasing familiarity in both reasoning systematically and the scope and applicability of the Guideline Principles, increasing sophistication can be established and documented over time using case studies based on authentic problems. The steps in ethical reasoning, ASA Ethical Guideline Principles, and the most challenging aspects of their intersection are each explored in a series of tables that can be used for developing in-class discussion, assignments, or structuring discussion and practice.

3. Results

Table 1 presents each ASA Ethical Guideline Principle (rows) and walks the reader through the application of that Guideline Principle to/in each of the steps of ethical reasoning (columns). The 2016 ASA Ethical Guidelines appear in the Appendix.

Reading Table 1 across a single row outlines how, if ASA Guideline Principle A (professional integrity and accountability) is to be learned or applied, the analysis of any given example can be structured so that each of the steps in ethical reasoning are applied.

Reading Table 1 down a single column outlines how each of the ethical reasoning steps can be learned and practiced across cases or examples. For Guideline Principles D-F (responsibilities to research subjects (D), research team colleagues (E) and to other statisticians/statistics practitioners (F)), the structures are similar enough that the description of the application of each ethical reasoning step is identical (collapsing across rows, not columns). However, each ethical reasoning step can and should be applied separately to considerations that are relevant to each specific obligation (subjects/team colleagues/other statisticians).

TABLE 1: Walking through the steps of Ethical Reasoning using the ASA Ethical Guidelines: executing ethical reasoning steps with each Guideline Principle.

Ethical Reasoning Steps:	Identify/ assess prerequisite knowledge	Recognize an ethical issue (decision that must be made)	Identify relevant decision-making frameworks (e.g., virtue or utilitarianism)	Identify and evaluate alternative actions	Make & justify a decision	Reflect on the decision
2016 ASA Guideline Principle:						
A. Professional integrity and accountability	To engage in ethical reasoning, the level of professional knowledge/ training must be sufficient to identify an ethical issue (when in doubt, ask for help!). *	Ethical issues in statistical practice arise whenever one or more ASA Guideline Principles *or their constituent elements* cannot be followed. Understanding "professional integrity and accountability" is essential.	The way to decide how to resolve the ethical issue must involve a framework for weighing different options; **virtue** (prioritizing obligations to the profession) and **utilitarianism** (prioritizing the action that results in the least harm) are two straightforward methods.	Actions that the ethical issue requires must also be identified – e.g., whether to ask a colleague or mentor for help, or to share the ASA Guidelines with the client/ collaborator, or to notify authorities that inappropriate use of the results of the analysis are being promulgated. These alternatives can be evaluated using the decision-making frameworks.	The default decision on ethical challenges can seem to be, "do nothing – and avoid that situation in the future". This decision is difficult-but not impossible-to justify.	Alerting colleagues in the profession about the situation can be accomplished by creating cases for teaching the ASA Ethical Guidelines; understanding how the ethical challenge arose – these are two ways to reflect on an ethical decision making process in order to prevent it in the future and to strengthen professional integrity for all practitioners.

Ethical Reasoning Steps: 2016 ASA Guideline Principle:	Identify/ assess prerequisite knowledge	Recognize an ethical issue (decision that must be made)	Identify relevant decision-making frameworks (e.g., virtue and utilitarianism)	Identify and evaluate alternative actions	Make & justify a decision	Reflect on the decision
B. Integrity of data and methods	If the integrity or source of the data, or proscribed methods, cannot be ascertained, that may constitute an ethical challenge.	Articulating (and then ensuring inclusion of) limitations and assumptions in reporting comprise decisions that often yield challenges (e.g., due to space) that are ethical in nature for the data analyst.	Both virtue ethics and utilitarianism can fail to promote decisions that are consistent with these ASA Guidelines when all stakeholders (i.e., not solely the analyst and the funder/client) are considered. *	The default alternatives can appear to be "acknowledge" and "do not acknowledge" limitations of the data and/or assumptions. Even articulating that this is a decision – and these are the (first) two alternatives considered - can – support more ethical and professional practice.	The justification for a decision should be based on the evaluation of the alternative approaches to the limitations and assumptions inherent in the data and analysis, respectively.	Reflecting on the decision entails considering what went better and what could be improved for future engagement. The analyst can feel the least amount of control over data –but always retains control over the methods to be employed and how results are presented.

Ethical Reasoning Steps:	Identify/ assess prerequisite knowledge	Recognize an ethical issue (decision that must be made)	Identify relevant decision-making frameworks (e.g., virtue and utilitarianism)	Identify and evaluate alternative actions	Make & justify a decision	Reflect on the decision
2016 ASA Guideline Principle:						
C. Responsibilities to Science/ Public/ Funder/Client	Obligations to stakeholders can conflict themselves, leading to ethical challenges for the analyst. Prerequisite knowledge can include understanding all stakeholders and their perspectives on the data/analysis/ results/ interpretation.	Ethical challenges can often arise when responsibilities to the funder/ employer and those to the scientific community are in conflict. These can be compounded when career considerations are added.	Virtue ethics and utilitarianism function best when all stakeholders are correctly identified; responsibilities can be prioritized *only* when all stakeholders are considered.	Alternative actions must be concretely articulated to be evaluable, irrespective of the decision-making frameworks that are utilized. Balancing and prioritizing responsibilities given the perspectives of all stakeholders can be challenging – so justification (based on concrete evaluation) is crucial.	Making *and justifying* decisions is important when multiple stakeholder perspectives must be addressed. It can be helpful to articulate a perspective/ stakeholder (e.g., science or the profession) that would tend to be prioritized most highly most often.	If an analyst chooses one stakeholder (e.g., science or the profession) to which the highest priority would be given most often, then reflection on decisions can follow naturally from the effects of making and justifying decisions that are consistent with this approach.

Ethical Reasoning Steps: 2016 ASA Guideline Principles:	Identify/ assess prerequisite knowledge	Recognize an ethical issue (decision that must be made)	Identify relevant decision-making frameworks (e.g., virtue and utilitarianism)	Identify and evaluate alternative actions	Make & justify a decision	Reflect on the decision
D. Responsibilities to research subjects **E. Responsibilities to research team colleagues** **F. Responsibilities to other statisticians or statistics practitioners**	Articulating prerequisite knowledge that is sufficient to identify and make informed and justifiable decisions may involve different sources of knowledge, but the assessment of it will be similar for all three of these Guideline Principles.	Ethical challenges can arise with respect to the treatment of research subjects (and colleagues in and outside the profession) but they are more likely to arise when responsibilities to these different research participants come into conflict.	When balancing goods and harms (utilitarianism), consideration of research subjects, team colleagues, and other statisticians can be helpful and informative. When using a virtue ethics approach to selection and justification of alternative actions, it may be more helpful to choose one perspective to compare and contrast the effects of decisions on the other perspectives.	Although the perspectives of these three types of stakeholders may differ, the evaluation of alternative actions that are identified for a given ethical challenge can be synergistic. Decisions may be multifaceted or may proceed in stages; the extent to which the options are concretely articulated promotes thorough evaluation.	The decision, as well as its justification, must balance the analyst's responsibilities to these three types of stakeholder.	Reflection on decisions that are made based on considerations of the analyst's responsibilities to stakeholders in these three groups may focus on the decision making framework or how feasible it is to prioritize decision making in terms of each group (or all together).

Ethical Reasoning Steps: 2016 ASA Guideline Principle:	Identify/ assess prerequisite knowledge	Recognize an ethical issue (decision that must be made)	Identify relevant decision-making frameworks (e.g., virtue and utilitarianism)	Identify and evaluate alternative actions	Make & justify a decision	Reflect on the decision
G. Responsibilities regarding allegations of misconduct	Prerequisite knowledge sufficient to engage this Guideline Principle competently and confidently may be one of the most crucial – for confident identification of real misconduct and confident identification of other behaviour that is not misconduct. *	Ethical issues may arise from observation, allegation, or actual commission of misconduct, or activities that may be construed as such.	In addition to engaging the decision making frameworks that include utilitarianism and virtue ethics, legal considerations may also come into play when determining a course of action relating to allegations of misconduct.	While the identification of alternative actions relating to these ethical issues may be clear cut (or proscribed), their evaluation can be very complex.	The justification of decisions about ethical issues arising from the observation, allegation, or actual commission of misconduct, or activities that may be construed as such must be explicit and must utilize evidence to the highest degree of any of the Guideline Principles.	Reflecting on decisions relating to the observation, allegation, or actual commission of misconduct, or activities that may be construed as such should emphasize both personal development (awareness of self and relation to the scientific or professional communities) *and* the program or process within which these responsibilities were engaged.

Ethical Reasoning Steps:	Identify/ assess prerequisite knowledge	Recognize an ethical issue (decision that must be made)	Identify relevant decision-making frameworks (e.g., virtue and utilitarianism)	Identify and evaluate alternative actions	Make & justify a decision	Reflect on the decision
2016 ASA Guideline Principle:						
H. Responsibilities of employers, including organizations, individuals, attorneys, or other clients employing statistical practitioners	Understanding the differences between the responsibilities of the analyst and those of the employer is essential to promoting employers' understanding of these/their obligations. Familiarity with the codes of professional or ethical conduct from different professions is important prerequisite knowledge for this Guideline Principle.	It can be challenging to identify ethical issues that arise specifically from failures of others to recognize and act on their responsibilities. Most professions have codes of professional or ethical conduct, so those can help to identify and articulate ethical challenges in this Guideline Principle.	While virtue ethics and utilitarianism can be useful for reasoning through statistical ethical challenges, those might not be the best frameworks for decision making by the employers. Other frameworks may be preferred.	The simplest alternative actions under this Guideline Principle are often "employer does" vs. "employer does not" follow their organization's ethical code or permit me to follow this one. Even this superficial treatment can be made evaluable, particularly if a formal code is available.	The justification for action on this Guideline Principle is *post hoc*, since it is created based on what the employer does, and not based on the decision by the analyst themselves.	Reflection on decisions relating to this Guideline Principle tend to be limited to focus on the program, institution, or context in which employers' decisions were observed or experienced. However, this can still be useful and informative for the analyst –if only for making future plans.

*Many institutions and businesses offer ethics/bioethics and even ombudsperson consultation to support and strengthen responsible conduct across scientific disciplines. These supports should be sought and utilized whenever ethical challenges arise that seem beyond the individual's ability to reason through or resolve.

One of the more challenging steps in ethical reasoning – arguably one of the most important ones – is the identification of the ethical challenge about which this reasoning is required. Table 2 presents two "cases" (very simplified), and walks through each ASA Guideline Principle for this single ethical reasoning step, in order to demonstrate how each Principle can be used to either identify the/an ethical challenge or to suggest a potential solution to the challenge that the case may raise.

Table 2. Using the ASA Ethical Guidelines for Professional Practice to *identify ethical challenge(s).*

Case 1. The client/collaborator does not know how to present, or is not committed to presenting, the correct, transparent interpretation of results.

ASA Guideline Principle	Principle-identified challenges/decisions to be made
A. Professional integrity and accountability B. Integrity of data and methods	The data analyst will execute their professional obligations to the best of their abilities; no ethical challenges are identified using either of these Guideline Principles.
C. Responsibilities to Science/Public/Funder/Client	*Challenge*: the analyst has obligations – to science and to the public (and to a funder if funding is involved) to ensure that the collaborator/client uses (interprets, presents) their results responsibly.
D. Responsibilities to research subjects	Because the data were already collected, as the analyst fulfills Guideline Principles A & B, responsibilities to research subjects are met.
E. Responsibilities to research team colleagues	*Challenge*: the analyst has obligations to all members of the research team to ensure that the collaborator/client uses (interprets, presents) their results responsibly.
F. Responsibilities to other statisticians or statistics practitioners	*Potential solution:* This Guideline Principle can be used to help encourage collaborator/client responsible use of the statistical results.
G. Responsibilities regarding allegations of misconduct	*Challenge*: the analyst's obligations to ensure that the collaborator/client uses their results responsibly implies that, if misconduct is encountered, the analyst has additional obligations that will arise.
H. Responsibilities of employers, including organizations, individuals, attorneys, or other clients employing statistical practitioners	*Potential solution:* This Guideline Principle can be used to help strengthen the resolve of the collaborator/client to use the statistical results *responsibly*.

Case 2. Client/collaborator is not aware of statistical concepts of sampling, bias, etc. and may not be able to identify important confounders. Their data are already collected and you are committed to planning and executing the analysis.

ASA Guideline Principle	Principle-identified challenges/decisions to be made
A. Professional integrity and accountability	*Challenge*: The ethical data analyst will execute their professional obligations to the best of their abilities; if the data were collected in a biased way, analyses and the interpretations that are supportable are very limited.
B. Integrity of data and methods	*Challenge*: The ethical data analyst will analyze the data in the manner that is most consistent with the integrity of the data – in order to minimize bias and maximize transparency. This is particularly important when the analyses will be used to support policy decisions.
C. Responsibilities to Science/Public/Funder/Client	*Potential solution*: This Guideline Principle can be used to help encourage collaborator/client to accept the most appropriate analyses/results given the data – unifying the team's commitment to the responsible use of the statistical results.
D. Responsibilities to research subjects	Because the data were already collected, as the analyst fulfills Guideline Principles A & B, responsibilities to research subjects are met.
E. Responsibilities to research team colleagues	*Challenge*: The analyst must prioritize their obligations to the profession (F) and to science/the public (C) over other perceived obligations to members of the research team by analyzing the data using methods that are appropriate given the data and their origins.
F. Responsibilities to other statisticians or statistics practitioners	*Potential solution:* This Guideline Principle can be used to help encourage collaborator/client responsible use of the statistical results.
G. Responsibilities regarding allegations of misconduct	*Potential solution:* the analyst's obligation to avoid misconduct can be used to help explain the critical nature of transparency and defensible interpretations of statistical results –particularly as they derive from potentially biased data.
H. Responsibilities of employers, including organizations, individuals, attorneys, or other clients employing statistical practitioners	*Potential solution:* This Guideline Principle can be used to help engage a collaborator/client in discussions about the documented limitations on the statistical results that derive from the data collection procedures.

In Table 2, the first "case" involves a client or collaborator who is either not able to present, or is not committed to presenting, the correct and transparent representation of

the results of an analysis. This general case can arise in a variety of situations. A client may lack sufficient knowledge and understanding of statistical concepts to interpret results provided by a statistician or to appropriately use these results in making a decision. A client may also be interested in advocating for a particular decision or course of action and may have engaged a statistician with the hope of being provided a supportive result.

Ethical challenges can be articulated by appealing to Principles C (responsibilities to science/funder/public/client), E (responsibilities to research team colleagues), and G (responsibilities regarding allegations of misconduct). Potential solutions (which would be useful in the next ethical reasoning step, articulating and evaluating alternative actions –see Table 3) could come from Principles F (responsibilities to other statistics practitioners) and H (responsibilities of employers). Importantly, the fact that the client/collaborator is not committed to the correct action is not, in itself, the ethical challenge. The ethical challenge for the analyst comes from the *specific decision that they must make* to deal with the situation created by the client/collaborator.

In the second "case" in Table 2, (client/collaborator is not aware of confounders or potential sources of bias in already-collected data), again, it is the decision that the analyst must make in this situation that gives rise to the ethical challenge for the analyst. This general case also frequently arises in statistical practice. For example, a client focused on providing a particular program or service may have not considered other factors that could affect target outcomes or, even if such factors were considered, data may not have been consistently collected on these other factors. A client may also lack expertise in measuring outcomes of interest, which could lead to bias (e.g., using leading questions on questionnaires). Bias can also arise through a client's lack of knowledge, experience, or resources to randomly sample from a target population.

In case 1, ethical challenges did not arise from the application of ASA Guideline Principles A (professional integrity) or B (integrity of data and methods), but in case 2, these are two of three potential sources of ethical challenges (with Principle E, responsibilities to research team colleagues being a third potential source for identifying the ethical challenge facing the analyst). Potential solutions to the second case may be found in Principles C responsibilities to science/funder/public/client), F (responsibilities to other statisticians), G (responsibilities regarding allegations of misconduct) and H (responsibilities of employers).

Table 3 focuses on how the ASA Guideline Principles can be applied in another difficult step in the process of ethical reasoning, the identification/articulation and evaluation of alternative actions given the particular ethical challenge that was identified. The specific ethical challenges that are identified as facing the analyst, derived from the ASA Guidelines, in the two cases in Table 2 are revisited in Table 3. Three generic responses are articulated:

1. Do nothing.
2. Engage a colleague in formulating a response.
3. Report the client or collaborator.

It is essential for the practitioner (and the reasoned) to recognize and acknowledge that to "do nothing" is to make a response to an ethical challenge; while it seems implausible, it is actually a very common response. Thus, it is well worth considering, because whether

or not this is the conscious, purposeful decision, it is often the decision that is made. In cases where a practitioner does not feel sufficiently empowered or otherwise able to discuss an ethical challenge directly with a client, engaging a colleague in formulating a response is a viable alternative. The chosen colleague could be one with greater experience or sophistication in reasoning through or responding to an ethical challenge, or could have a different relationship with the client (e.g., the colleague could be a professor who serves as a mentor to a student practitioner).

Table 3. Using the ASA Ethical Guidelines for Professional Practice to *articulate and evaluate alternative actions.*

Case 1. The client/collaborator does not know how (or is not committed) to the correct, transparent interpretation and/or presentation of results.
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Alternative actions:
Do nothing;
Engage a colleague to formulate a response;
Report the client/collaborator.

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ASA Guideline Principle	Principle-identified alternative actions and their evaluation
A. Professional integrity and accountability B. Integrity of data and methods	**Do nothing**: this alternative is *not consistent with Principle A.* **Engage a colleague** to formulate a response: consistent with Principle A **Report the client/collaborator**: Principle A is not informative about this alternative. Principle B is *not informative* for any of these alternatives.
C. Responsibilities to Science/Public/Funder/Client	**Do nothing**: this alternative is *not consistent with Principle C.* **Engage a colleague** to formulate a response: consistent with Principle C. **Report the client/collaborator**: consistent with Principle C, but only with simultaneous application of Principle G as well.
D. Responsibilities to research subjects	Principle D is not particularly informative for any of these alternatives; however, **doing nothing** to address an ethical challenge tends to prioritize other stakeholders over the research subjects –implicitly or explicitly.
E. Responsibilities to research team colleagues	**Do nothing**: this alternative is *not consistent with Principle E.* **Engage a colleague** to formulate a response: consistent with Principle E, one option is to engage others on the research team to formulate a response. **Report the client/collaborator**: consistent with Principle E, but only with simultaneous application of Principle G as well and possible, consideration of the ethical obligations of these other team members.

F. Responsibilities to other statisticians or statistics practitioners	**Do nothing**: this alternative is *not consistent with Principle F.* **Engage a colleague** to formulate a response: consistent with Principle F and other statisticians may have similar experiences to share. **Report the client/collaborator**: Principle F is not specifically informative about this alternative, but the analyst in the situation may be able to prevent other analysts from being entangled in a similar situation by formally reporting the situation.
G. Responsibilities regarding allegations of misconduct	**Do nothing**: this alternative is *not consistent with Principle G.* **Engage a colleague** to formulate a response: consistent with Principle G, although everyone who is consulted must also understand their responsibilities regarding what actually constitutes misconduct. **Report the client/collaborator**: consistent with Principle G.
H. Responsibilities of employers, including organizations, individuals, attorneys, or other clients employing statistical practitioners	**Do nothing**: Principle H is not informative about this alternative action. **Engage a colleague** to formulate a response: Principle H may be informative about this alternative. **Report the client/collaborator**: Principle H is not specifically informative about this alternative action.

Case 2. Client/collaborator is not aware of statistical concepts of sampling, bias, etc. and may not be able to identify important confounders. Their data are already collected and you are committed to planning and executing the analysis.

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Alternative actions:
Do nothing;
Engage a colleague to formulate a response;
Report the client/collaborator.

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ASA Guideline Principle	**Principle-identified alternative actions and their evaluation**
A. Professional integrity and accountability	**Do nothing**: this alternative is *directly opposed to* Principle A; professional integrity is required to plan and execute a defensible, appropriate analysis. **Engage a colleague** to formulate a response: consistent with Principle A. **Report the client/collaborator**: Principle A is not informative about this alternative.
B. Integrity of data and methods	**Do nothing**: this alternative is *directly opposed to Principle B; combined with Principle A*, the analyst is obliged to plan and execute an analysis consistent with the data. **Engage a colleague** to formulate a response: consistent with Principle B. **Report the client/collaborator**: Principle B is not informative about this alternative.

C. Responsibilities to Science/Public/Funder/Client	**Do nothing**: this alternative is *not consistent with Principle C.* **Engage a colleague** to formulate a response: consistent with Principle C. **Report the client/collaborator**: consistent with Principle C, but only with simultaneous application of Principle G as well.
D. Responsibilities to research subjects	Principle D is not particularly informative for any of these alternatives; however, **doing nothing** to address an ethical challenge tends to prioritize other stakeholders over the research subjects –whether implicitly or explicitly.
E. Responsibilities to research team colleagues	**Do nothing**: this alternative is *not consistent with Principle E.* **Engage a colleague** to formulate a response: consistent with Principle E, one option is to engage others on the research team to formulate a response. **Report the client/collaborator**: consistent with Principle E, but only with simultaneous application of Principle G as well and possible, consideration of the ethical obligations of these other team members.
F. Responsibilities to other statisticians or statistics practitioners	**Do nothing**: this alternative is *not consistent with Principle F.* **Engage a colleague** to formulate a response: consistent with Principle F and other statisticians may have similar experiences to share. **Report the client/collaborator**: Principle F is not specifically informative about this alternative, but the analyst in the situation may be able to prevent other analysts from being entangled in a similar situation by formally reporting the situation.
G. Responsibilities regarding allegations of misconduct	**Do nothing**: this alternative is *not consistent with Principle G, bu*t that is not because the client/collaborator is engaging in misconduct necessarily. Principle G is *always* relevant. **Engage a colleague** to formulate a response: consistent with Principle G, although everyone who is consulted must also understand their responsibilities regarding what actually constitutes misconduct. **Report the client/collaborator**: consistent with Principle G.
H. Responsibilities of employers, including organizations, individuals, attorneys, or other clients employing statistical practitioners	**Do nothing**: this alternative is *not consistent with Principle H.* The analyst can, at a minimum, inform the client/collaborator of their responsibilities when data are insufficiently documented (as in this case). **Engage a colleague** to formulate a response: Principle H may be informative about this alternative. **Report the client/collaborator**: Principle H is not specifically informative about this alternative action.

As can be seen in Table 3, "doing nothing" when faced with an ethical challenge is an alternative action in every case – and this specific alternative is inconsistent with nearly every ASA Ethical Guideline Principle. The best "evaluation" of this alternative action occurs when it arises because one of the eight Guideline Principles is simply not informative about that alternative. *In no case* does a Principle support/is a Principle consistent with "doing nothing". However, it is essential to recognize that "doing nothing" when faced with an ethical challenge is an actual decision – and this decision is contrary to the ASA Ethical Guidelines for Professional Practice.

The other two admittedly generic alternatives ("engage a colleague to formulate a response" and "report the client/collaborator") are *evaluable* – although when an individual is actually engaging in the steps of ethical reasoning to address a challenge they encounter during a collaboration, more specific alternative actions will very likely be identified.

4. Discussion

The application of statistics – by individuals who self-identify as "statisticians" as well as by any others who do not, and yet who do engage in data analysis – is increasingly *transdisciplinary.* The result of this characteristic is that "professionalism", or the inclination to appeal to Guidelines for Professional Practice, may not naturally evolve for the practitioner. The ethical reasoning approach to the identification of, and response to, ethical challenges that arise from engagement with data targets the decision-making that is inherent to a practitioner's work (Bollier, 2010; see also Boyd & Crawford, 2012; Dwork & Mulligan 2013), independent of the practitioner's discipline. Therefore, this method for ethical reasoning can actually be applied across a wide range of contexts - for the same individual over time, or a diverse group of practitioners (e.g., a research team or data analysis group –or, consulting course/degree-seeking cohort).

As is discussed briefly about the three options described in Table 3, "doing nothing" does not seem like a "real" choice, and its inconsistency with the Guidelines is not surprising. It serves as both a reminder that to do nothing is to *make the choice to do nothing*; and as one extreme of the continuum of options that the statistical analyst has. The other end of the continuum, to "report the collaborator", may seem equally extreme. However, it should be contemplated when appropriate. In fact, one of the ASA Ethical Guideline principles (G) specifically articulates the obligation of the data analyst to know what constitutes misconduct – and to act appropriately when this is observed or experienced. The purpose of including this wide range of options is to encourage practitioners to consider these articulated options, as well as those that fall in between. In this sense, these tables are intended to be flexible and adaptable to the variety of actual experiences as well as case studies that are available from a variety of online and open-source resources (outlined in Tractenberg, 2016-c).

As of the 2013-14 academic year, only 35% of US universities required any ethics content for even *some* of their students in statistics and biostatistics programs (Lee et al. 2015). The ASA Ethical Guidelines are complex – as is statistical consulting – and the ASA Guidelines require both *instruction* and *practice,* particularly to learn how to prioritize the Principles during statistical consultation (see Tractenberg & FitzGerald, 2012; Tractenberg, 2016-c). With a growing interest in pro bono statistical consulting – as well as for open and citizen science – information that can support self-directed as well

as in-class learning of the ASA Guidelines and how to apply them is timely and important. In the United States, two ASA-based organizations engage directly in pro bono statistics: Statistics Without Borders and the Statistics in the Community (StatCom) Network. There are international organizations involved in, or involving, pro bono consultation as well (e.g., the Royal Statistical Society's "statisticians for society" initiative, http://www.rss.org.uk/rss/get_involved/statisticians_for_society/rss/get_involved/statistic ians_for_society.aspx?hkey=c7977c58-1558-495a-9e5a-e99d64ea9cfd and DataKind http://www.datakind.org). This paper has presented strategies and approaches to engagement in ethical reasoning using the 2016 revised ASA Ethical Guidelines. Consulting examples have been extrapolated and generalized from actual experiences, so as to be applicable or adaptable to any statistical work. Our purpose was to demonstrate ethical reasoning *both* for instructors interested in adding this feature to consulting courses *and* for students or consultants who wish to build experience, and evidence of engagement, with the ASA Ethical Guidelines (see also Tractenberg et al. 2015). Because of the affinity between the ASA and Royal Statistical Society's (RSS) Ethical Guidelines (RSS, 2014), RSS members– and anyone practicing in a context that uses either the ASA or RSS Ethical Guidelines - can utilize these materials easily.

APPENDIX: ASA ETHICAL GUIDELINES – REVISED

Ethical Guidelines for Statistical Practice

Prepared by the Committee on Professional Ethics
of the American Statistical Association
Approved   by   ASA   Board   April   2016

Purpose of the Guidelines

The American Statistical Association's Ethical Guidelines for Statistical Practice are intended to help statistics practitioners make decisions ethically. Additionally, the Ethical Guidelines aim to promote accountability by informing those who rely on statistical analysis of the standards that they should expect. The discipline of statistics links the capacity to observe with the ability to gather evidence and make decisions, providing a foundation for building a more informed society. Because society depends on informed judgments supported by statistical methods, all practitioners of statistics, regardless of training and occupation or job title, have an obligation to work in a professional, competent, and ethical manner and to discourage any type of professional and scientific misconduct.

Good statistical practice is fundamentally based on transparent assumptions, reproducible results, and valid interpretations. In some situations, Guideline principles may conflict, requiring individuals to prioritize principles according to context. However, in all cases, stakeholders have an obligation to act in good faith, to act in a manner that is consistent with these Guidelines, and to encourage others to do the same. Above all, professionalism in statistical practice presumes the goal of advancing knowledge while avoiding harm; using statistics in pursuit of unethical ends is inherently unethical.

The principles expressed here should guide both those whose primary occupation is statistics and those in all other disciplines who use statistical methods in their professional work. Therefore, throughout these Guidelines, the term "statistician" includes all practitioners of statistics and quantitative sciences, regardless of job title or field of degree, comprising statisticians at all levels of the profession and members of other professions who utilize and report statistical analyses and their implications.

A. Professional Integrity and Accountability

The ethical statistician uses methodology and data that are relevant and appropriate, without favoritism or prejudice, and in a manner intended to produce valid, interpretable, and reproducible results. The ethical statistician does not knowingly accept work for which he/she is not sufficiently qualified, is honest with the client about any limitation of expertise, and consults other statisticians when necessary or in doubt.

 The ethical statistician:

1. Identifies and mitigates any preferences on the part of the investigators or data providers that might predetermine or influence the analyses/results.

2. Employs selection or sampling methods and analytic approaches appropriate and valid for the specific question to be addressed, so that results extend beyond the sample to a population relevant to the objectives with minimal error under reasonable assumptions.

3. Respects and acknowledges the contributions and intellectual property of others.

4. When establishing authorship order for posters, papers, and other scholarship, strives to make clear the basis for this order, if determined on grounds other than intellectual contribution.

5. Discloses conflicts of interest, financial and otherwise, and manages or resolves them according to established (institutional/regional/local) rules and laws.

6. Accepts full responsibility for his/her professional performance. Provides only expert testimony, written work, and oral presentations that he/she would be willing to have peer reviewed.

B. Integrity of data and methods

The ethical statistician is candid about any known or suspected limitations, defects, or biases in the data that may impact the integrity or reliability of the statistical analysis. Objective and valid interpretation of the results requires that the underlying analysis recognizes and acknowledges the degree of reliability and integrity of the data.

The ethical statistician:

1. Acknowledges statistical and substantive assumptions made in the execution and interpretation of any analysis. When reporting on the validity of data used, acknowledges data editing procedures, including any imputation and missing data mechanisms.

2. Reports the limitations of statistical inference and possible sources of error.

3. In publications, reports, or testimony, identifies who is responsible for the statistical work if it would not otherwise be apparent.

4. Reports the sources and assessed adequacy of the data; accounts for all data considered in a study and explains the sample(s) actually used.

5. Clearly and fully reports the steps taken to preserve data integrity and valid results.

6. Where appropriate, addresses potential confounding variables not included in the study.

7. In publications and reports, conveys the findings in ways that are both honest and meaningful to the user/reader. This includes tables, models, and graphics.

8. In publications or testimony, identifies the ultimate financial sponsor of the study, the stated purpose, and the intended use of the study results.

9. When reporting analyses of volunteer data or other data that may not be representative of a defined population, includes appropriate disclaimers and, if used, appropriate weighting.

10. To aid peer review and replication, shares the data used in the analyses whenever possible/allowable, and exercises due caution to protect proprietary and confidential data, including all data that might inappropriately reveal respondent identities.

11. Strives to promptly correct any errors discovered while producing the final report or after publication. As appropriate, disseminates the correction publicly or to others relying on the results.

C. Responsibilities to Science/Public/Funder/Client

The ethical statistician supports valid inferences, transparency, and good science in general, keeping the interests of the public, funder, client, or customer in mind (as well as professional colleagues, patients, the public, and the scientific community).

The ethical statistician:

1. To the extent possible, presents a client or employer with choices among valid alternative statistical approaches that may vary in scope, cost, or precision.

2. Strives to explain any expected adverse consequences of failure to follow through on an agreed-upon sampling or analytic plan.

3. Applies statistical sampling and analysis procedures scientifically, without predetermining the outcome.

4. Strives to make new statistical knowledge widely available to provide benefits to society at large and beyond his/her own scope of applications.

5. Understands and conforms to confidentiality requirements of data collection, release, and dissemination and any restrictions on its use established by the data provider (to the extent legally required), and protects use and disclosure of data accordingly. Guards privileged information of the employer, client, or funder.

D. Responsibilities to Research Subjects

The ethical statistician protects and respects the rights and interests of human and animal subjects at all stages of their involvement in a project. This includes respondents to the census or to surveys, those whose data are contained in administrative records, and subjects of physically or psychologically invasive research.

The ethical statistician:

1. Keeps informed about and adheres to applicable rules, approvals, and guidelines for the protection and welfare of human and animal subjects.

2. Strives to avoid the use of excessive or inadequate numbers of research subjects, and excessive risk to research subjects (in terms of health, welfare, privacy, and ownership of their own data), by making informed recommendations for study size.

3. Protects the privacy and confidentiality of research subjects and data concerning them, whether obtained from the subjects directly, other persons, or existing records. Anticipates and solicits approval for secondary and indirect uses of the data, including linkage to other data sets, when obtaining approvals from research subjects,

and obtains approvals appropriate to allow for peer review and independent replication of analyses.

4. Knows the legal limitations on privacy and confidentiality assurances and does not over-promise or assume legal privacy and confidentiality protections where they may not apply.

5. Considers whether appropriate research-subject approvals were obtained before participating in a study involving human beings or organizations, before analyzing data from such a study, and while reviewing manuscripts for publication or internal use. The statistician considers the treatment of research subjects (e.g., confidentiality agreements, expectations of privacy, notification, consent, etc.) when evaluating the appropriateness of the data source(s).

6. In contemplating whether to participate in an analysis of data from a particular source, refuses to do so if participating in the analysis could reasonably be interpreted by individuals who provided information as sanctioning a violation of their rights.

7. Recognizes that any statistical descriptions of groups may carry risks of stereotypes and stigmatization. Statisticians should contemplate, and be sensitive to, the manner in which information is framed so as to avoid disproportionate harms to vulnerable groups.

E. Responsibilities to Research Team Colleagues

Science and statistical practice are often conducted in teams made up of professionals with different professional standards. The statistician must know how to work ethically in this environment.

The ethical statistician:

1. Recognizes that other professions have standards and obligations, that research practices and standards can differ across disciplines, and that statisticians do not have obligations to standards of other professions that conflict with these Guidelines.

2. Ensures that all discussion and reporting of statistical design and analysis is consistent with these Guidelines.

3. Avoids compromising scientific validity for expediency.

4. Strives to promote transparency in design, execution, and reporting or presenting of all analyses.

F. Responsibilities to Other Statisticians or Statistics Practitioners

The practice of statistics requires consideration of the entire range of possible explanations for observed phenomena, and distinct observers drawing on their own unique sets of experiences can arrive at different and potentially diverging judgments about the plausibility of different explanations. Even in adversarial settings, discourse

tends to be most successful when statisticians treat one another with mutual respect and focus on scientific principles, methodology and the substance of data interpretations. Out of respect for fellow statistical practitioners, the ethical statistician:

1. Promotes sharing of data and methods as much as possible and as appropriate without compromising propriety. Makes documentation suitable for replicate analyses, metadata studies, and other research by qualified investigators.

2. Helps strengthen the work of others through appropriate peer review; in peer review, respects differences of opinion and assesses methods, not individuals. Strives to complete review assignments thoroughly, thoughtfully, and promptly.

3. Instills in students and non-statisticians an appreciation for the practical value of the concepts and methods they are learning or using.

4. Uses professional qualifications and contributions as the basis for decisions regarding statistical practitioners' hiring, firing, promotion, work assignments, publications and presentations, candidacy for offices and awards, funding or approval of research, and other professional matters.

5. Does not harass or discriminate.

G. Responsibilities Regarding Allegations of Misconduct

The ethical statistician understands the difference between questionable scientific practices and practices that constitute misconduct, avoids both, but knows how each should be handled.

The ethical statistician:

1. Avoids condoning or appearing to condone incompetent or unethical practices in statistical analysis.

2. Recognizes that differences of opinion and honest error do not constitute misconduct; they warrant discussion, but not accusation.

3. Knows the definitions of, and procedures relating to, misconduct. If involved in a misconduct investigation, follows prescribed procedures.

4. Maintains confidentiality during an investigation, but discloses the investigation results honestly to appropriate parties and stakeholders once they are available.

5. Following an investigation of misconduct, supports the appropriate efforts of all involved, including those reporting the possible scientific error or misconduct, to resume their careers in as normal a manner as possible.

6. Avoids, and acts to discourage, retaliation against or damage to the employability of those who responsibly call attention to possible scientific error or misconduct.

H. Responsibilities of Employers, Including Organizations, Individuals, Attorneys, or Other Clients Employing Statistical Practitioners

Those employing any person to analyze data are implicitly relying on the profession's reputation for objectivity. However, this creates an obligation on the part of the employer to understand and respect statisticians' obligation of objectivity.

Those employing statisticians are expected to:

1. Recognize that the Ethical Guidelines exist, and were instituted, for the protection and support of the statistician and the consumer alike.

2. Recognize that valid findings result from competent work in a moral environment. Employers, funders, or those who commission statistical analysis have an obligation to rely on the expertise and judgment of qualified statisticians for any data analysis. This obligation may be especially relevant in analyses that are known or anticipated to have tangible physical, financial, or psychological impacts.

3. Recognize that the results of valid statistical studies cannot be guaranteed to conform to the expectations or desires of those commissioning the study or the statistical practitioner(s).

4. Recognize that it is contrary to these Guidelines to report or follow only those results that conform to expectations without explicitly acknowledging competing findings and the basis for choices regarding which results to report, use, and/or cite.

5. Recognize that the inclusion of statistical practitioners as authors, or acknowledgement of their contributions to projects or publications, requires their explicit permission because it implies endorsement of the work.

6. Support sound statistical analysis and expose incompetent or corrupt statistical practice.

7. Strive to protect the professional freedom and responsibility of statistical practitioners who comply with these Guidelines.

Acknowledgements

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