

Operationalizing Ethical Becoming as a Theoretical Framework for Teaching Engineering Design Ethics

Grant A. Fore & Justin L. Hess

Science and Engineering Ethics

ISSN 1353-3452

Sci Eng Ethics

DOI 10.1007/s11948-019-00160-w



Your article is protected by copyright and all rights are held exclusively by Springer Nature B.V.. This e-offprint is for personal use only and shall not be self-archived in electronic repositories. If you wish to self-archive your article, please use the accepted manuscript version for posting on your own website. You may further deposit the accepted manuscript version in any repository, provided it is only made publicly available 12 months after official publication or later and provided acknowledgement is given to the original source of publication and a link is inserted to the published article on Springer's website. The link must be accompanied by the following text: "The final publication is available at link.springer.com".



Operationalizing Ethical Becoming as a Theoretical Framework for Teaching Engineering Design Ethics

Grant A. Fore^{1,2} · Justin L. Hess³

Received: 24 May 2019 / Accepted: 23 November 2019
© Springer Nature B.V. 2019

Abstract

Ethical becoming represents a novel framework for teaching engineering ethics. This framework insists on the complementarity of pragmatism, care, and virtue. The dispositional nature of the self is a central concern, as are relational considerations. However, unlike previous conceptual work, this paper introduces additional lenses for exploring ethical relationality by focusing on indebtedness, harmony, potency, and reflective thought. This paper first reviews relevant contributions in the engineering ethics literature. Then, the relational process ontology of Alfred North Whitehead is described and identified as the foundation of the ethical becoming concept. Following this, ethical becoming is imagined as comprising five components: relationality and indebtedness, harmony and potency (i.e., beauty), care, freedom and reflective thought, and ethical inquiry. Each component will be unpacked and knit together to argue that (1) becoming in all its forms is relational and, therefore, whatever becomes is indebted to all to which it relates; (2) one's ethical engagement must be directed toward the creation of harmony and potency; (3) care practices are necessary to ensure that multiplicity is valued and safeguarded in the meeting of needs; (4) the capacity for reflective thought is necessary to fashion one's self and others in the direction of harmony, potency, and care; and (5) ethical thought and action must operate through a cycle of ethical inquiry. This paper will close with a brief exploration of how ethical becoming could be utilized in engineering education contexts.

Keywords Engineering ethics · Process · Care · Reflection · Inquiry

✉ Grant A. Fore
gfore@iupui.edu

Justin L. Hess
hessjl@iupui.edu

¹ STEM Education Innovation and Research Institute, Indiana University Purdue University Indianapolis, Indianapolis, USA

² Department of Anthropology, University of Cape Town, Cape Town, South Africa

³ School of Engineering Education, Purdue University, West Lafayette, USA

Introduction

This article argues for a fivefold conceptualization of ethical becoming, which brings new and integrates existing ethical perspectives from the engineering ethics landscape. First, ethical becoming asserts that the self is perpetually incomplete and indebted to relationships that, taken together across its experiential history, constitute the self. Second, since one's self is indebted to a multiplicity of continuous encounters with diverse others—which have value not just for others, but for their own selves and the whole—one is obligated to ensure that whatsoever becomes through a present encounter is a potent and harmonious actualization of difference or, in more poetic terms, beautiful. Third, as a disposition and a practice, care is important to ensure that what is fashioned (whether it is the self, an other, a design, or a prototype) addresses present needs and safeguards multiplicity. Fourth, as a necessary component of ethical becoming, reflective thought is needed for the self's fashioning of itself and others and thereby for its freedom to do so repetitiously. To remain mindful of one's fundamental incompleteness and indebtedness and to act pragmatically toward the creation of potent and harmonious actualities, one must have the capacity for reflective thought. Finally, intentional fashioning of self and others involves a process of reflective inquiry that creates new actualizations in the form of thoughtful experiments—sometimes successful, sometimes not—that are always open for further creative contestation and iteration.

The purpose of this article is to unpack the concept of ethical becoming and to establish its relevance as a framework for teaching engineering design ethics. In what follows, *being* is something achieved through a constant process of *becoming*. *Being* is a relational, iteratively repetitious, and emergent process guided by one's experiences, one's practices, one's milieu, and the influences of others one encounters along the way. This is not to suggest that processes of becoming are one-sided. Rather, they involve co-emergence, or multi-emergence, in which relationships, feelings and expressions between a multiplicity of entities mold each other. *Being* is an actualization of potential and its continuity of *becoming* is achieved relationally, or through one's relationships with others.

The manuscript opens with an exploration of current trends in engineering ethics and engineering ethics education. Thereafter, the underlying foundation of the ethical becoming concept, Alfred North Whitehead's relational process ontology, is described. Then, the five key components of ethical becoming are explored in their respective sections. Finally, the article concludes by connecting the theory to potential practices.

Background: Current Trends in Engineering Ethics Education

Defining Engineering Ethics

As described by Hess and Fore (2018), definitions for ethics are multiple and contested within engineering education literature. Davis (2006) argues for three separate categories of ethics: (1) “ordinary morality,” (2) a “field of philosophy,” and (3) special discipline-specific “standards” beyond ordinary morality. In this brief section, it is argued that all three of these aspects are equally important for engineering ethics, specifically the framework of ethical becoming described herein. With that said, rules and codes currently hold a place of privilege across engineering ethics and engineering ethics education (Hess and Fore 2018). While rules and codes found in discipline-specific standards are undoubtedly important, they are insufficient by themselves for moral inquiry and ethical judgment.

The insufficiency of any one approach to ethical judgment has been argued by many authors. For example, Harris (2008) focused on the insufficiency of rules. He argued that rules cannot be applied in all instances since, inevitably, engineers must sometimes utilize judgment and discretion in their work. Furthermore, engineering rules tend to carry negative connotations because they indicate what engineers should *not* do, not what they *should* do. Hence, they place an emphasis on non-maleficence (above all else, do no harm) and deemphasize the goodness and beauty that engineers aspire to create.

Secondly, Harris (2008) argues that applying rules requires an internal or motivational element more substantive than, for example, the pursuit of compliance out of fear of sanction. Developing this further, Harris considers the virtue of compassion written as a rule that requires engineers to “Help those in need, when appropriate.” But, he points out, one can *help those in need* but have no internalized concern for the other. For Harris, this is an issue. In such an instance, the question “has one abided by the rule in question” would elicit an affirmative response. Yet, if the spirit in which one adheres to the rule lacks care and concern then it exemplifies uncritical rule following. In other words, following a rule because one desires the good that could arise from one’s compliance differs from following a rule simply because one unthinkingly believes that all rules ought to be followed.

Another critique of codes or rules is their somewhat static nature. As codes tend to be preventative, they are often created or revised only after an issue is encountered. Hence, they are reactive rather than proactive. Seeking to ascertain what would be encompassed by a set of canons focused on social justice, Riley and Lambrinidou (2015) identified a need for such canons to be adaptive and to arise from practices of “cultural and epistemic humility.” Engaging in such practices would lead engineers to “acknowledge the imperfection and incompleteness of the[ir] canons and [to] strive to improve the profession’s values, principles, and standards through inviting open feedback from others” (Riley and Lambrinidou 2015, p. 11). Doing so requires deemphasizing objectivity, which indicates that practicing ethics as a lived activity is fundamentally subjective.

When philosophically conceptualized, ethics can comfortably subsume “ordinary” and discipline-specific morality. If one were to entertain the idea of ethics as a fashioning of self within and through relational encounters in reference to how one believes one should live, then morality, whether ordinary or discipline-specific, would be aptly described as tools or technologies through which one actualizes one’s vision of the ethical self. When “doing” ethics, one asks the question, *How ought I (or we) live?* As one proceeds through present encounters, one works to fashion oneself in the image of one’s answer. This paper is, in part, concerned with ethics as a creative process that involves the application of certain tools (e.g., reflective thought, inquiry, rules, codes, values) to facilitate one’s ethical becoming.

Philosophical Ethics, Care, and Virtue

This section aims to summarize how ethical frameworks relevant to the conceptualization of ethical becoming have been treated in the engineering ethics education literature. Ethical becoming is deeply indebted to several philosophical theories, which have found few applications in the engineering ethics literature and curriculum. Frameworks with some, albeit limited, applications include: virtue (Harris 2008; Schmidt 2014), pragmatism (Nair and Bulleit 2019), and care (Hess et al. 2016; Nair and Bulleit 2019; Pantazidou and Nair 1999; Riley 2013). The aim of this review is to establish the vital importance of relationality and virtuous dispositions, which exist—but are still emergent—in engineering ethics teaching and scholarship.

Nair and Bulleit (2019) argue for a combined philosophy of pragmatism and care, envisioning an engineering ethics aligned with the everyday realities of engineering practice. Not only do the precepts of pragmatism and the relational elements of care act as substantive tools for making ethical engineering decisions, they also contain dispositional dimensions and, therefore, evoke virtue ethics. Hence, Nair and Bulleit (2019, p. 14) argue for a complementary overlap between care ethics and virtue ethics. They argue further that, while a virtuous agent seeks to act in ways congruent with their perception of the “good”, goodness varies from case to case; and that a “Virtue ethics ... requires context-sensitive practical judgment (phronesis) to discern the best course of action in a given situation” (Nair and Bulleit 2019, p. 19). Likewise, Harris (2008) argues for the merit of virtue-based approaches that incorporate technical and non-technical excellences where the latter is fundamentally relational and emphasizes other-oriented dispositional considerations. For example, techno-social sensitivity involves (a) motivation to discern societal impacts of technical systems; (b) respect for nature that elicits an appreciation of nature’s beauty and a recognition of one’s place in nature; and (c) commitment to public good that prioritizes conduct above and beyond professional roles.

Particularly in their emphasis on relationality above universals, these considerations run parallel to feminist ethics. As Riley (2013, p. 191) argues, feminist ethics refute suppositions that “relationships and social or political context are mere distractions” while also embracing notions that “ethical decisions are necessarily imperfect.” Riley (2013) identifies the historic presence of feminist paradigms in engineering ethics through the work of Caroline Whitbeck, a feminist philosopher

and renowned engineering ethics scholar. In contrast with other prominent engineering ethics textbooks that offer step-wise or universal reasoning processes, Whitbeck (2011) emphasizes grappling with ambiguity in particular instances, recognizing that such ambiguity is grounded in politics, in issues of power, and in social *isms* (i.e., racism, feminism). She thus deemphasizes universal modes of achieving ethical solutions. For Whitbeck, ethics is and ought to be relational and inclusive of difference, albeit, while navigating the realities of socio-political power. Similarly, Riley (2013) argues, efforts to contextualize the ethical within engineering ought to be interdisciplinary and incorporate myriad fields in decision-making processes, all considerations that align directly with the ethical becoming framework.

Teaching Ethics to Engineers

Hess and Fore's (2018) consideration of instructional strategies for engineering ethics education reveals at least four significant gaps: (1) learning goals are seldom directed at developing ethical dispositions; (2) philosophical theories are rarely engaged and, when they are, seldom through the lenses of virtue and care; (3) pedagogical strategies are designed mostly around codes, case studies, and classroom discussion, as opposed to experiential learning modes; and (4) there exists a paucity of clear documentation regarding what and how ethics is taught and assessed.

However, this does not mean that there has been no scholarly consideration of ethical dispositions, philosophical theories, or community-based learning in engineering ethics education. It does, however, suggest that the translation of such scholarly work has yet to occur broadly in the pedagogical literature. The result is that, to some extent, these areas have not been fully integrated into ordinary engineering ethics education praxis. This article is primarily concerned with addressing the first three listed gaps. However, to do that requires an explanation of how ethical becoming, as a philosophical concept, can help to address those gaps. To draw connections between theory and practice, we continually ask "How can ethical becoming as a philosophical concept contribute to the growth of students' ethical dispositions and practice?" and "How can an ethical becoming framework be presented in such a way so that others might utilize it in their engineering instruction?"

Relational Process Ontology: Whitehead, Dewey, and Nyamnjoh

The concept of ethical becoming is grounded in an ontological framework that draws primarily from Alfred North Whitehead's (1967, 1978) process philosophy. Adequately detailing Whitehead's entire relational process ontology, a very complicated metaphysical system, is far beyond the scope of this essay and has been exceptionally elaborated elsewhere (Deleuze 1993; Henning 2005; Shaviro 2012; Sherburne 1966; Stenner 2008; Wallack 1980). However, playfully wading out into the ocean of Whitehead's speculative philosophy helps to conceptualize ethical becoming.

Whitehead (1934, p. 36) asserted that—rather than assuming concreteness—*activity, process, and inter-relationality* better represented a reality consistent with

contemporary scientific findings. Whitehead aimed to construct a conceptual framework for *process* that could be used to describe every *actual occasion*, “from the most infinitesimal atomic events...to [our] subjective experience of this room right here and now” (Stenner 2008, p. 99). These actual occasions are “drops of experience” that are “complex and interdependent” (Whitehead 1978, p. 18); furthermore, according to Whitehead, everything is made up of these relational events of experience.

The assertion that everything is “made up” of actual occasions does not mean that there is no difference between things. It means that differences between things are differences in “degree” (of complexity) not of “kind” (Henning 2005, p. 73). With that said, the difference between such “atomic” actual occasions and the complex, personal consciousness of a human subject is signified by Whitehead’s notion of a “society” of actual occasions (or even “societies of societies”). Such a society has endurance and is multitudinous, highly complex, and structured (Wallack 1980, p. 81). With the complexity or “the intensity of coordination” found in humans comes the capacity for the “conceptual entertainment of possibilities” (Henning 2005, p. 73). Humans can perceive and entertain innumerable potentialities while an “atomic” actual occasion may lack such abilities. The features of the relational process at play in a becoming actual occasion apply to societies like the human subject.

This can be beneficially explored through Whitehead’s (1967, 1978) notion of *prehension*. As the word implies, prehension is concerned with grasping or *apprehending* objects within any given actual occasion. Whitehead refers to these prehended objects as “data” or individual “datum.” Such grasping of data is informed by a subject’s “subjective form,” or how it “feels” or demonstrates “concern” toward an object. As a becoming-subject interacts with data, it is affected by these data (or *prehends* them) and, through this interaction, a new subject, which Whitehead calls a “superject,” is created. The superject, then, is the concrete actualization of potential that itself becomes a datum. Moreover, the superject is characterized as having “objective immortality;” that is, it has the capacity to be prehended as part of any future actual occasions, each of which is “constituted by [its] synthesis of other actual [occasions]” (Sherburne 1966, p. 24). An actual occasion, then, is both a superject (i.e., a prehended object) and a prehending subject (Sherburne 1966, p. 35). Through process, the past, and the once actualized novelties objectified within it, continue to exert their influence on the immediate present.

The above echoes John Dewey’s work, specifically that in *Experience and Education* (1998), where he describes a process that flows by means of “continuity” and “interaction”. Here, Dewey uses “continuity” to refer to “the continuity of experience,” in which a subject continuously draws on its past in the form of knowledge abstracted from previous experiences. The subject then brings prior experience to bear on its “interactions” with other subjects/objects within future events. As a whole, this process is described as flowing along an “experiential continuum.” Dewey’s conceptualization of process is arguably commensurate with Whiteheadian process and becoming. It could even be argued that Dewey’s primary contribution to the conceptualization of ethical becoming is in the potential in his work to characterize such a process as *learning*. The relationship between becoming and learning is explored further in a later section.

Whitehead's work also has significant parallels with Nyamnjoh's (2017) work on African ontologies. While Nyamnjoh approaches the becoming subject from a vastly different angle than Whitehead, his work has significant parallels with Whitehead's philosophy outlined above. Specifically, Nyamnjoh articulates the nature of the subjects' incompleteness by drawing on the literary works of Amos Tutuola, wherein African notions of subjectivity (and, more generally, reality) privilege *incompleteness* over completeness. An emphasis on the latter, he argues, comprises a hegemonically persistent colonial holdover. Nyamnjoh's (2017, p. 2) conceptualization of incompleteness insist that reality is "dependent on interconnections, relatedness, open-endedness, and multiplicities." Nyamnjoh's work in relation to Whitehead is further unpacked in the *Relationality* section.

Finally, to close this section, it is important to acknowledge precisely the consequences that adopting a relational process ontology may have on how ethics is conceptualized. The features of a Whiteheadian process ontology are of ethical import because: (1) one's self and the "natural world" are made of the same stuff: process; and (2) one is, at any given present moment, what one prehends, and what one prehends is comprised of every object/subject to which one relates or has related. The phenomenal experience of *being* anything at all is dependent upon encounters with difference. If each one is indebted in such a fundamental way, what obligations does one have to the things that participate in one's becoming? How does one thoughtfully and critically seek to fulfill such obligations? How does one strategically guide students through their ethical formation and create learning environments conducive to achieving such an objective?

Ethical Becoming's Key Components

As the name suggests, *ethical becoming* refers to becoming in an ethical way. In other words, becoming is a process by which individual subjects (human/non-human; conceptual/material) are relationally fashioned and refashioned. For becoming to be ethical, the process must be subject to reflective thought, be practice oriented, and be aimed at the actualization of diverse potentialities. Ethical becoming, moreover, proceeds from a critical consideration of the question "How ought one live?" Ethical becoming implies that an answer to that question must be to live life in the continuously unfolding present while also reflecting upon and considering one's resulting experience in and for one's future becomings. Thus, an ethical becoming must include reflective (re)fashioning of a subject in relation to a diversity of affective forces, or data, within any given event. While everything may become, it is possible that only humans, with their complex nervous systems, have the evolved capacity for reflective thought necessary for *ethical* action.

Table 1 summarizes the five key components of ethical becoming. Each component builds from Whitehead's relational process ontology that establishes the self and others as continually becoming subjects.

The next sections further unpack these components. First, it is shown how ethical becoming is concerned with the experience of relationality, particularly regarding what counts as an actor within a relational process; and how, if at all, a subject

Table 1 Brief descriptions of each component of the ethical becoming concept

Component	Description
Relationality and indebtedness	Subjects are not fashioned in a vacuum; their actualization is <i>indebted</i> to the relational data that contribute to their becoming
Harmony and potency	Due to this relational indebtedness, one is obligated to direct one's aspirations toward the creation of actualities that are inclusive of the greatest possible difference (<i>harmony</i>) and contain intense, or suitably complex, affective force (<i>potency</i>)
Care	Since all subjects are (re)made through encounters with plurality, it is necessary reflectively to practice <i>care</i> for difference to ensure that what becomes is harmonious and potent
Freedom and reflective thought	Through the capacity for <i>reflective thought</i> in action, subjects express their <i>freedom</i> to fashion their selves and what they co-create through their relations with their selves and others
Ethical inquiry	As a mode of creation, <i>ethical inquiry</i> provides a heuristic that applies direction and intention to the natural process of becoming

is indebted to other such actors for their role in that subject's constitution. Second, given that individual subjects are relationally constituted by other actors who are reciprocally constituted, it is shown that every actuality has value within a creative process. Henning's (2005) *Ethics of Creativity* is utilized here to examine how the becoming of harmonious and potent actualities occurs through the inclusion or exclusion of other valued actualities. Third, Tronto's (1993) *Ethic of Care* is drawn on to argue for the imperativeness of providing care throughout this process. Fourth, it is explained that carefully navigating one's trajectory through processes of actualization requires capacity for reflective thought with a dispositional sensitivity toward fashioning one's self and others with care toward the achievement of harmonious and potent actualities. It is through such principled reflective thought that one can wield one's freedom consciously to fashion one's self, others, and the things one makes. Fifth, drawing on Dewey (1988), it is shown that ethical inquiry provides a frame in which to situate and direct *reflective thought* toward considerations of relational *indebtedness*, *value*, *harmony*, *potency*, and *care*.

Component I: Relationality and Indebtedness

Ethical becoming is, first and foremost, a relational process. Reflective thought (see Component IV) is subsequent to one's experience of relational encounters. Any effort to conceptualize the componential constitution of ethical becoming, therefore, should begin with relationality before proceeding to considerations of how one should think about all to which one relates.

As a core feature of relationality, and in alignment with Nyamnjoh (2017), this section argues (1) that the becoming subject is perpetually incomplete and indebted to everything that constitutes it and (2) that what counts as a lender/creditor extends beyond the boundaries of human relationships. Specifically, Nyamnjoh (2017, p. 61) recognizes "incompleteness as our fundamental ontological status," meaning that one's perpetual becoming is marked by its interdependence to all with which

it relates. Each relational encounter is followed by another relational encounter. In short, one becomes and becomes and becomes, never achieving completion.

A return to Whitehead may be constructive. In Whitehead's philosophy, every entity is a prehending subject and a prehended object. If a human subject can prehend (or be affected by, or feel) an animal, a plant, a mineral, or an abstract idea, then *anything* can be a source of potential for an actualization. This leads to another question: are these prehended objects then agents? Latour (2004, p. 75) differentiates between the relational impacts of non-human actors versus human agents via his notion of "actants," which are "interveners" capable of "modifying[ing] other actors" within and across various encounters. Relating this back to Whitehead, one could think of non-human actants as prehended data that contribute to a new subject's becoming.

While Nyamnjoh's ontological perspectives should not be characterized as Whiteheadian or Latourian, the scholarship of each parallels that of the others. Considering one's indebtedness to such actants in one's becoming—and the becoming of what one makes—initiates a movement from Whitehead's ontology of relational processes to an axiology of such an ontology. This movement is necessary due to the presupposition that, for something to be lent, it must have some *value*. If one is an *ethical* subject, one must respond to the valued entities who have influenced what one has become. Therefore, to be an ethical subject, one must see and be aware of one's obligations/debts. The shape of these obligations, as understood through an aesthetic lens, are introduced in the next section.

Component II: Harmony and Potency

This section utilizes Henning's (2005) *Ethics of Creativity* to argue that ethical becoming is dependent upon one's (1) acknowledgment of the value of each of the entities one encounters and (2) openness to including those entities in harmonious and potent actualities. Since the question of value was discussed in the previous section, this section will focus on harmony and potency. When discussing harmony and potency, it is important to first acknowledge that they constitute a conceptualization of beauty put forward by Henning (2005), following Whitehead (1967, 1968) and Hartshorne (1970). However, given the baggage that the term "beauty" carries with it, for the purposes of conceptualizing ethical becoming it is better to focus on what it means for an actualization (i.e., a becoming) to be harmonious and potent.

According to Henning (2005, p. 128), harmony is the "ideal mean between ... unity and diversity" and potency, or intensity,¹ is the ideal mean between "simplicity and complexity." Beauty is achieved when harmony and potency are ideally maximized. When seeking harmony within a given encounter the available data could be so plentiful as to be chaotic, thereby producing significant uncertainty and, with it, fear and stagnation. That means that sometimes diversity is ignored in favor of one's

¹ While both Henning (2005) and Hartshorne (1970) use the word *intensity*, for the conceptualization of ethical becoming, the related word *potency* is preferred for the purposes of this paper, as it better connotes the affective force of an actuality to influence or modify other becoming subjects.

perceived comfort with a homogeneity that has no use for the values held in, and the potentials offered by, difference. Following Whitehead (1967), Henning (2005, p. 113) describes this as “anesthesia” which, he says, “results from an individual’s failure to act on opportunities that would increase the depth of its beauty [or harmony].” To this, Henning (2005, pp. 113–114) adds that an individual may also commit “violence” by actively destroying entities that could have otherwise contributed to a deeper achievement of beauty/harmony.

While a great diversity of entities may well be perceived as discordant and tempt one to work toward anesthesia or violence, such diversity can also liberate one to deepen the harmony and potency of a becoming subject by assembling compatible contrasts that enhance the values present within an actualization. It may be useful to think of potency as the affective force of a beautiful actuality. While a unification of diversity may have harmony, there is also a chance that such harmony could lack efficacy in luring other becoming subjects to feel orprehend it. That is because, to achieve beauty, harmonizing parts must have a unified potency that draws one to it and that mediates its contributions to future actualities.

As Henning (2008, p. 129) indicates, the aim of any experience must be to “include as much diversity as possible without sacrificing the unity of experience”; it must also be to avoid the superficiality of the overly simplistic and the ungraspable profundity of an unwieldy complexity. In order to achieve the harmony and potency of a beautiful actuality, Henning (2005, p. 146) argues for an ethics of creativity that necessitates five obligations: (1) beauty, (2) self-respect, (3) love, (4) peace, and (5) education. For the obligation of *beauty*, one’s action must be directed toward “the greatest possible universe of beauty, value, and importance in each situation possible” (ibid.). The obligations of *self-respect* and *love* demand that one “maximize the harmony and intensity” of both one’s own experiences and the experiences of all that one encounters, respectively (ibid.). The obligation of *peace* asserts that, unless the greatest beauty possible in a given experience is threatened by a failure to destroy another entity, one should refrain from such destructive actions. The obligation of *education* demands that an individual should always be striving to grow their “aesthetic horizons,” meaning that one must actively seek awareness of both the values present in any given encounter and what kinds of beautiful actualizations are possible therein. For ethical becoming to occur, effort must be exerted to recognize and meet these obligations.

Component III: Care Practice

Though not framed as such by Henning, the fulfillment of his five obligations would demand a substantial amount of care for oneself (see Component IV), as well as for what one encounters, to ensure the achievement of maximum harmony and potency in new actualizations. So, how can care practices contribute to such achievements? According to Tronto (1993, p. 103) care practices include “everything that we do to maintain, continue, and repair our ‘world’ so that we can live in it as well as possible.” Caring, in this sense, is an exercise not only in self-building but also in world-building, a world-building that does not exclude

non-humans (*ibid.*). It means that, within encounters, one is *attentive* to the needs of others, accepts *responsibility* to attend to those others' needs, is *competent* in providing care to address those needs, and is sensitive to care-recipients' *responses* (Tronto 1993, p. 127). The italicized words constitute Tronto's four elements of an ethic of care. Particularly important for present purposes is Tronto's focus on the existence of a particular need that must be addressed in a care encounter.

Harmony and potency may seldom be the most immediate needs of the present. This, however, does not mean that they are unimportant; rather, by addressing a need with appropriate care, not only does one potentially meet the immediate need but one may also maximize harmony and potency in what becomes. To achieve that, one's practice must be tempered with care and one's sights must be directed toward creating harmonious and potent actualities.

In order to address needs in beautiful ways, each element of an ethic of care is necessary, but for the purposes of this paper, responsiveness needs greater attention. This is because the element of responsiveness is where one can witness both the value and affective force of the care given. A care recipients' responsiveness to the care given fulfills a reciprocal obligation to return care within an economy of intimacy. Whether conscious or unconscious, a care recipient's response will affect a caregiver in some way; and that in turn will affect the character of their future interactions and that which is potentially created from those interactions. Expanding upon this, caring demands a careful and empathic prehension of others in whatever one is co-implicated in making, whether that making is of one's self as an individual subject, of the other as another subject, or, for example, of a design (e.g., a technology, a policy, an intervention, an architectural document, etc.) that may prove useful in addressing a collective problem.

The above treatment of responsiveness is admittedly an elaboration on Tronto's (1993, p. 135) conceptualization, which is more concerned with the recognition of the vulnerability of the care recipient due to the potential for abuse. As a subordinate part of this component of ethical becoming, practicing responsiveness is not about merely recognizing that care recipients actually respond—and that this is important because they are in a state of vulnerability—but that their response has the power to affect the care giver. It shows that exchanges occur within care encounters where the parties involved are fashioning each other and their ideas around how and what care should be performed (Fore 2013). Put differently, things are being made through care. Drawing on Ingold's (2013, p. 108) work on *making*, one could think of responsiveness in terms of "correspondence." By being in correspondence, one is compelled to answer to the movement of a world (i.e., the care that is given and its effects) that one is always in the process of feeling. This leads to the question: Is it possible to correspond with the world, to recognize indebtedness, to work toward beauty, and to provide care without the capacity for reflective thought? The next section explores the necessity of reflective thought for undertaking ethical endeavors and achieving ethical becoming.

Component IV: Freedom and Reflective Thought

Any realization of ethical becoming requires reflective thought in order to fashion a self that is committed to recognizing indebtedness, to continually achieving harmony and potency, and to practicing care—all of which are undergirded by a relational process ontology. According to Foucault, it is thought that constitutes one's freedom to enact the process of fashioning one's self. As he says (1997, p. 117): "Thought is freedom in relation to what one does, the motion by which one detaches oneself from it [i.e., one's actions], establishes it as an object, and reflects on it as a problem." In other words, reflective thought follows experience and makes it possible for one to critically consider all of the actors/actants that played a role in the experience, what the ultimate results of the experience were, and how, given these results, one might modify one's attitudes and actions in the future.

This reflective thought is essential each time a subject exerts efforts to relate to itself, or to provide *care* to itself; it is one possible technique to be practiced toward the becoming of an ethical subject. Foucault (1997, p. 284) further unpacked ethics when he described ethics as "the considered form freedom takes when it is informed by reflection." Moreover, much of his late scholarship during his "ethical turn" was concerned with reflective thought (e.g., through meditation, reading, writing, conversation), which was a key focus of the ancient Greek practice of *care of the self*. As Foucault (1997) stressed, the purpose of such care of the self was and still is to know oneself and reflectively to actualize oneself with and through others and in relation to one's desired (and contextually contingent) direction of change.

For example, were one concerned with an end of maximizing harmony and potency and of providing care for the diversity through which this might be achieved, one must utilize one's capacity for reflective thought to be able to make one's practices the objects of critique. By critiquing one's practices, one employs a technology for iterating one's self. If, upon assessing one's previous actions, they are found to be inappropriate for the context, one can then adjust one's practice to meet that context in a new, possibly more efficacious, way.

It would be naïve, however, to assume that such reflective prowess could be attained without the guidance of a teacher. A guide or teacher is needed for a student to perfect and provide direction to such a process of caring for the self and for others. As Foucault (1997, p. 287) indicates, an individual who is still learning to care for their self is in need of "a guide, counselor, or friend, someone who will be truthful with [them]." In educational settings focused on engineering design processes, such guidance could provide students with direction on how to reflectively fashion the self, and the practices that may define each, in relation to a desired direction of change. Before exploring the role of education in the practice of ethical becoming, it is important first to explore ethical becoming's final component, *ethical inquiry*.

Component V: Ethical Inquiry as Mode of Creation

The fifth component, ethical inquiry, serves as a heuristic structure for reflectively directing the process of becoming toward the realization of the ends one desires (e.g., indebtedness, incompleteness, beauty) and the careful meeting of present needs. As conceptualized here, ethical becoming assumes the use and modification of thought and action through participation in, and reflection on, meaningful encounters—comprising multiple intervening forces—that continuously fashion new subjects. As one proceeds through such becoming, there is potential for one to *inquire* thoughtfully into how one might ideally live, think, act, and create. Building upon Dewey (1988), the present focus on ethical becoming is less concerned with determining one's duty and compliance than it is oriented towards exploring how one should live, participate, and interact with others along an experiential continuum that itself comprises a multitude of moral situations. It involves, in part, conscious reflection upon one's prior experiences and how those mediate who one becomes and what one (co-)creates.

Ethical inquiry, as imagined from within the ethical becoming concept, is a process of critical inquiry in which the individual, when immersed in present events of moral significance, must act (e.g., make and implement decisions) according to their conscious knowledge of their moral values, their past applications of that knowledge, and their observations of the present needs of—and actors within—the moral situation (*ibid.*). This leads to experiential data collection and analysis and, in turn, to the refashioning of the individual subject and to the reflective production of new resolutions, knowledge, and ethical valuing (*ibid.*). It follows that ethical and experiential practice operate in a manner that is commensurate with the scientific process used across science and engineering fields (*ibid.*).

While Dewey never created a prescriptive structure for ethical inquiry, there are at least five important features of the process as he described it that are worth considering in greater detail. First, ethical inquiry must include the practice of “*moral traits*”—such as “the virtues or moral excellencies” (Dewey 1988, p. 174). Such moral excellencies are important, because there is never one end that, if pursued, will sufficiently address all situations. For example, the pursuit of the utilitarian end of the greatest good for the greatest number will not be the soothing balm for all moral situations. For the ethical becoming concept, harmony, potency, and care are not static ends that are finally perfected; rather, like moral excellencies, they are “directions of change” (Dewey 1988, p. 181). While one may aim to achieve harmony, potency, and care in their lives, attainment of these directions of change are not final; one grows in their ability to achieve an ongoing harmony, potency, and care in the world one participates in actualizing. As Dewey (*ibid.*) asserts, “growth”—or “becoming,” for the purposes of this paper—“is the only moral ‘end.’” One’s attained skillfulness in achieving beauty and care in the world is not an end in itself; rather, these skills “are marks of growth [i.e., becoming] and [the] means to [their] continuance” (Dewey 1988, p. 185). This speaks directly to the idea that students’ ethical capacities are emergent. One’s refinement of how one engages in the ethical becoming process will, of course, not be achieved in a degree program, let alone a single course. One’s ethical becoming is a lifelong pursuit.

Secondly, Dewey (1988) argued, one must reflect deeply upon, or build an *awareness* for, the multitudinous elements comprising a dynamic and pluralistic moral situation. Such awareness begins through careful observation of all the elements contributing to a present problem and a thoughtful analysis of how those elements are contributing. Third, once sound awareness of a situation has been achieved, one must make a *judgment* in which one must identify what should be done in the unique situation. Fourth, this judgment leads to active *experimentation* during which one's judgment may be confirmed if the evidence, or the consequences of the experiment, supports its validity (Dewey 1988, p. 179). Fifth, if the consequences of such an experiment refutes one's judgment, this constitutes a "lesson in wrong methods" that could lead to a new *iteration* of the faulty judgment and another experiment (Dewey 1988, p. 180).

Summarizing the Entanglement of Ethical Becoming's Five Components

To summarize the above in a concise list, it logically follows from the five components of ethical becoming that:

- (1) one's correspondence with the world begins with the recognition that one is a relational creation and is, therefore, indebted; this indebtedness presupposes that everything has value;
- (2) due to this value and one's indebtedness, the multiplicity present in any encounter should be, to the best of one's ability, safeguarded to ensure that actualizations achieve a harmonious beauty containing sufficient potency/intensity;
- (3) care practices must be introduced to ensure that present needs are addressed and that the ideals of harmony and potency are achieved in what is actualized;
- (4) reflective techniques are needed for one to exercise the freedom to thoughtfully fashion oneself, others, and that which one makes with sensitivity to indebtedness, harmony, potency, and care; and
- (5) one's freedom to fashion in this way is beneficially directed through an ethical inquiry heuristic in which one must direct one's growth in decision-making and practice using moral traits and dispositions, increase one's awareness of the many entities playing a role in a given encounter, make a judgment about what should be done, enact that judgment as an experiment, and iterate on one's judgment based upon the outcomes of the experiment.

Ethical becoming could be thought of as a process of reflective inquiry and caring practice that seeks to recognize indebtedness and perpetuate the becoming of harmonious and potent actualities. As one accounts for, and strives to justly include, the diverse entities comprising a present encounter, one must inquire. When one inquires into all that comprises that encounter, one must reflectively account for one's self in all its complexity, traveling from one's experiential past along its lines of inheritance. As one brings past experience and future-oriented intentions to bear on any particular dynamic present, one conducts work that shapes new actualizations, which—though potentially not mirroring one's desired outcome(s)—are objectified

and become part of the becoming subject's experiential continuum. In fashioning a response to the world, one fashions one's self. Everything is in correspondence. There is no clear inside or outside. There is no disentangling from the world. That which one makes—whether that be one's self, others, or designs—resists closure, is contestable, and is open to modification.

Educating for Ethical Dispositions and Practice via Authentic Experience and Reflection

The above section on reflective thought (Component IV) concluded with an assertion that guides or teachers are necessary to help becoming subjects learn to fashion their selves in ethical ways. In the context of ethical becoming, this guidance should strongly encourage the learner to consider deeply all of the following: the reality of their relational connectivity; their indebtedness; their commitment to harmony, potency, and the practice of care; and their use of a heuristic for ethical inquiry capable of leading to new expressions of the self, of others, and of plans or designs that may address a collective need. The present section briefly explores the importance of experience—and reflection on that experience—when students are situated within authentic disciplinary contexts that hold potential for encounters with significant diversity and a plurality of needs all requiring negotiation. It concludes with a consideration of critical reflection in authentic experiential contexts and suggests several philosophically-informed reflective prompts to draw out student reflection. Before proceeding, it is important to acknowledge that community-engagement, as a kind of experiential learning, is utilized as the hypothetical context for the examples that conclude this paper. This, however, does not mean that community-engagement—or engineering design education for that matter—is the only context in which ethical becoming is relevant.

Due to the centrality of reflective thought and inquiry to ethical becoming, ethical becoming should be understood as a learning process, specifically one that benefits from educational environments constructed to be conducive to the creation of experiences of growth. For Dewey (1998, pp. 28–29), such growth is multi-directional and education is consequently needed to direct student growth in ways that lead to “continuing growth in new directions” as opposed to growth that stymies opportunity or prematurely forecloses possibilities for experience. It follows that educators are tasked with constructing environments conducive to experiential learning in that they provide ingressions into new becomings, new understandings, and new potentialities for future experimentation. Within such environments, Dewey (1998, pp. 31–32) suggests, experience acts as a “moving force” with the quality of any subsequent experience—one that has been “moved” into—ultimately determining the value of preceding experience. For example, if one classroom experience leads to a new educational experience in which students' knowledge is further developed, the instructional strategy used within that initial experience might warrant continued utilization by instructors. If and when this occurs, it may breed a spirit of pedagogical experimentation within Deweyian education, producing a dynamic and emergent classroom environment.

Whenever an educator is responsible for constructing a fecund environment, s/he wields power to exert social control within the classroom. For Dewey (1998, p. 61), appropriate use of this power must be to establish learning opportunities within what he calls a “social enterprise” in which each student will have “an opportunity to contribute and to which all feel a responsibility.” Following a similar line of thinking, anthropologist Jean Lave and educational theorist Etienne Wenger (Lave and Wenger 1991) situate learning within “communities of practice” in which understanding is acquired dynamically by being constructed through contextually relevant practice. Such “communities” (e.g., disciplines, trades, etc.) in which that kind of meaningful practice is situated provide learners with opportunities for “legitimate peripheral participation” as they move along a knowledge continuum from novice to expert (ibid.). Legitimate peripheral participation modifies the focus of learning from “learning *from* talk to ‘learning *to* talk” within social environments and events that are meaningful to whichever discipline or skill is being taught (Lave and Wenger 1991, pp. 108–109). Moreover, it connects future science and engineering professionals with actual disciplinary practice, which—as Pantazidou and Nair (1999) have indicated—is arguably inherently ethical, since everyday disciplinary practice demands care and engagement across difference. Since the ethical potential of respective disciplinary practice is inherent to those practices, educational environments are needed that are conducive to authentic disciplinary practices. In such circumstances the lenses of philosophical ethical theories can then be utilized as tools for reflection-in-practice, thereby making explicit the otherwise implicit ethics within disciplinary practices.

One finds a significant emphasis on reflection as a central assessment tool in any ethics-centric pedagogy, especially experiential and community-engaged pedagogies. Reflection is necessary in these experiential learning contexts precisely because, as Dewey asserted, growth is multidirectional. Yet, since growth is not always of a positive nature, requiring students to engage in structured reflective thought can enable educators to assist students to critique their experiences. In an engineering design education context, guiding students through sound reflection practices can help them to engage critically with what they have designed, how their designs affect others (both human and non-human), how and what others contributed to their design, and how they are fashioning themselves—as engineers and as humans—through their embodiment of what they value. But what potential forms could this guided reflection take?

One possibility is Ash and Clayton’s (2009) DEAL (*Describe, Examine, and Articulate Learning*) framework or structure for critical reflection in experiential learning environments. Following this framework, students are given reflective prompts at different times throughout the class, unit, or semester. These prompts should encourage students to thoughtfully *describe* a specified course experience. They should also have students thoroughly *examine* this experience. Prompts to examine said experience should be aligned with, and designed specifically to the ends of achieving, select learning goals and their assessable objectives. Following the description and analysis of experiential data, explain Ash and Clayton (2009, p. 41), students should be prompted to *articulate* what they have *learned*

and also how it can be abstracted and applied to future experiences that may help to refashion and build upon the knowledge they have experientially constructed.

Moreover, as course assessments, these reflective prompts should be thoughtfully connected to one's learning goals and objectives. Ash and Clayton identify learning goals within experiential learning that arguably map well with ethical becoming. These three, broad learning goals are *personal growth*, *civic learning*, and *academic enhancement*. Each of these is germane in experiential/community-engaged engineering education contexts that seek to apply the concept of ethical becoming. For example, Ash and Clayton's goal to achieve personal growth may be achieved through the process of reflective thought that must be central to any pedagogical application of ethical becoming as a concept. Similarly, the civic learning goal resonates well with an approach to ethical becoming that focuses on: (1) reflective thought within a framework of ethical inquiry; (2) the relation between Whiteheadian harmony and potency; and (3) an ethic of care's dedication to caring for difference. The academic enhancement goal also aligns with ethical becoming through its inclusion of Tronto's concept of *competence*, a key element of care. For one to care for difference in the addressing of a problem, one must do so with competence. This means that the content knowledge and skills engineering students are expected to develop, and hopefully come to utilize exceptionally, within a course are fundamental to ethical practice and the process of ethical becoming.

Considering Ash and Clayton's personal growth goal leads to the questions: How can engineering instructors cultivate the dispositions of their students to care for their selves and others? What reflective prompts could facilitate such a process? Such prompts might encourage students to participate in Foucauldian "problematization"—a concept that Faubion (2001, pp. 97–98) describes as "that reflexive process through which one presents to oneself a certain way of acting or reacting, asks questions of it [and] examines its meaning and goals." Taking such a focus would reframe engineering design practices to be concerned as much with technical designs as with the design of an individual subject's identity as an engineer and a citizen. For example, prompts could include:

- What principles/morals/values do you try to live by? What, if anything, do you do to ensure that you are living according to these principles/morals/values?
- Is there a role model who exemplifies your principles/morals/values? How, if at all, do you work to be like them?
- How have you worked in order to live according to your principles/morals/values in your interactions with this course's community partner?

As for Ash and Clayton's goal of civic learning, instructors could aim to design prompts that provoke students into reflections on their feeling, caring for, negotiating, valuing, and incorporating plurality toward the achievement of harmony and potency within the community-based context in which they are designing. Some possible prompts, include:

- How do the future users define the problem and why does it matter to them?

- How were you affected by the community partner members' concern over their problem?
- How do you plan to incorporate local knowledge, beliefs, needs, and aspirations into your design? Are there any that you found to be completely incompatible with your design idea? What about them rendered them incompatible?
- Is there a harmony to the design? In other words, have you included as much diversity of thought and experience as possible?
- Is there an intensity or potency to the design? Does the design lure people to engage with it or respond to it?
- How have the members of the community partner received and responded to your care/design?
- How have you addressed feedback from the members of the community partner in your design?
- As you go about the design process, how are you caring for the members of the community partner?
- In retrospect, was the expression of care you enacted sufficient to the context in which you were working? Was the care offered by students/community partners/broader stakeholders in any way inappropriate or potentially damaging?
- Where do you locate yourself (e.g., your past experiences, beliefs, interests) in your final design? Where is the community partner? Where is the technical content of the course? Where is the broader social context?
- How, if at all, do you imagine you might apply in your future practice what you have learned about (1) the design process and (2) the role of ethics in design?

Such prompts are designed to develop the students' potential to systematically interrogate their ethical thought and action. Ethical becoming is emergent, and the skills to navigate this process need to be practiced and repeated. Students can ethically become within their degree programs, but there is no ultimate realization of the ethical subject that when reached ends the process of becoming. Students must be introduced to these ideas and repetitiously guided through such processes starting early on in their education to ensure that strong, reflective habits form and are likely to be carried throughout one's professional and civic life.

Case Example

To illustrate the ethical becoming concept and its utilization in engineering design education, this section offers a hypothetical example of an architectural technology student designing a commercial building for a community partner or "client." It also includes considerations that a teacher might implement in order to promote student ethical becoming. Given the authors' familiarity with architectural technology and civil engineering, this context is most-suited to their expertise.

Overview

Imagine an undergraduate student in an architectural technology course on commercial construction. In the course, the student engages with a community partner who serves as a “client” and who is interested in receiving architectural plans for a desired project. The student and her peers meet with the community partner to assess the scope of the client’s project. Along with concern for client desires, the student encounters the constraints and allowances of the International Building Code (IBC) and the Zoning Code, the need to apply 3D modeling software required for the course (Revit), instructor guidance and expectations, peer perspectives, and her own highly complex and idiosyncratic experiential history.

Exploring the Five Components

As this student designs her initial floor plans, she prehends relevant portions of the IBC and Zoning Code, instructor insights from their own experiential history as a professional architect, peer ideas about design principles/styles, technical support from peers more attuned to Revit, the client’s vision for the property, the building specifications, and her own beliefs and values. Her reflective thought on these myriad components facilitates her creating a particular design configuration. The student then presents this initial design to her client. The client prehends the design, its features, and its rationale, and provides formative feedback. The student prehends this feedback, or the parts she feels relevant, and uses it to reiterate her design. All of this also merges and constitutes the student-as-subject throughout the design process while leading to a final design iteration that is an assemblage of the components negotiated (or reflectively thought through) and mobilized by the student. While what is described above suggests a single reiteration, in practice, throughout the duration of the course, there are innumerable becomings or iterations of not just a design but of the student and of the objects/subjects to which she relates. Whether it be her own constitution as a subject, her design, or the others to which she relates, all are indebted to the others for what they become.

Now think of this student during one specific act of design: the creating of a double door in Revit. When creating the double door, the student prehends a datum, which contains the client’s expressed desire for double doors. She also prehends her knowledge of how to technically create a double door in Revit, and the obligation, via the International Building Code, that doors flow with the path of egress. The number of positive prehensions in this event are innumerable, so it is important to stress that these examples are in no way exhaustive. These three prehended datum are further actualized in the Revit file—itself a prehension of prehension—containing the design of the double door. What each subject actually *is*, in the immediate present, is a becoming assemblage or unity of a plurality of prehended data relevant to the present event.

Imagine that this student achieved some level of success as she completed her designs. Yet, it is possible that no efforts were taken by her to, as Nyamnjoh (2017,

pp. 69–70) puts it, “assume the responsibility of acknowledging and/or repaying the debt one owes others.” However, assuming her failure to recognize these debts, the successful completion of her designs would have been due, in part, to the influence of many different things, including her objectified past experiences (including all entities that contributed to those experiences) and feedback from clients, peers, and the course instructor. She is indebted to many (perhaps infinite) others whether or not such debts are acknowledged.

Surely, this student will be unable toprehend *everything*. However, doing so would not necessarily lead to a potent harmony but, quite possibly, to chaos and to a complexity that is exceedingly overwhelming and impractical. This student’s creation of a harmonious and potent design should not be assessed only according to the surface aesthetics of a style. Rather, the nuanced ways in which she, with great care, assembled together the plurality and complexity of the design needs to be considered when assessing whether what is made is harmonious and potent. As a designer, she is entangled in a process of negotiation, which includes working with the “voices” of several different entities. How she assembles all of this in a coherent and efficacious way leads to an achievement (or not) of an artefact that could be characterized as beautiful, insofar as it is deemed harmonious and potent both to the student and others.

To ensure that this student enhances her awareness of her indebtedness and that her efforts to create are directed toward care, harmony, and potency, the instructor must construct a reflection strategy that includes assessments prompting the student to explicitly identify and consider the value of the many things that influence her design. She must be guided in her efforts to reflectively fashion not just her design but herself in ways that value difference and is attentive to the myriad affective forces which drive her decision-making, as well as those which she may have neglected. She must be trained to think reflectively upon the role of other actors and actants in the becoming of herself and her designs. She also must resist converging on decisions that incorporate minimal diversity. For example, she could be asked to reflect upon the extent to which she considered and sought to include as many of her client’s desires as possible, as well as whether her design accurately reflected the exigencies of the IBC, which exists to ensure safety, and thus mitigate the loss of life. She could also critically reflect upon the technical skills and knowledge she utilized to address the problem and whether she did so competently.

To put this in terms of Tronto’s four elements of care, the student could also be asked to reflect upon how, if at all, she (1) was *attentive* to what the client needed regarding a design; (2) took *responsibility* for the need by working to create a thoughtful, harmonious, and potent design; (3) addressed the need by creating a design with *competence* relative to her level of content knowledge and technical skill mastery; and (4) heeded the *responsiveness* of the client to her design, leading to further design iterations. If—upon translating her experiences with the client, the IBC, her peers, her instructor, and her own subjective history—the student creates a design that is deemed insufficient by her client or instructor, she must consider the feedback, explore how she is going to respond, and then respond.

To ethically become, one must reflectively inquire in ways that recognize the centrality of connectivity and indebtedness, are inclusive of care practices, and

demonstrate a commitment to directing becoming toward harmony and potency. By aiding the student's critical reflection on her continuously evolving design throughout the semester, and utilizing an ethical becoming framework, the instructor will help her learn: (1) to negotiate values; (2) to increase her awareness of the actors/actants populating relevant design encounters; (3) to make contextually-appropriate judgments; (4) to experiment with such judgments; and (5) to iterate, based on feedback, if her design choices have failed to meet the client's needs. Seen through an ethical becoming lens, design iterations are the results of failed experiments, or failed attempts to assemble into a unified and potent creation all the disparate differences present within an encounter.

Without guidance, the student might engage in this iterative process with little critical thought on how and why the client's needs should be met. Thus, the how and why of the process may remain unconscious to her and she may uncritically enact habits based upon assumptions about the client/designer relationship or, far worse, blindly accept all feedback and thoughtlessly rush through another iteration in pursuit of a grade that is believed to be the key to getting a job with a good wage. The ethical becoming framework is offered as one way to pre-empt such outcomes.

Conclusion

Ethical becoming is the thoughtful fashioning of subjects with and through "others," broadly defined. The ethical becoming concept highlights the importance of one's reflective acknowledgment that one's self, and anything else one makes, is incomplete and in process, and that what one becomes and makes is indebted to the multitudinous others with which one interacts. What a subject becomes depends not just upon personal lines of inheritance from the past but also upon what data one encounters in an ephemeral present moment. With the evolved capacity for reflective thought, human subjects can direct their relational becomings in reference to their values and towards their desired ends.

For engineering students to engage fully in ethical becoming, they must enter into authentic environments that demonstrate disciplinary relevance. More importantly, those should be environments with opportunities for complex encounters with and between diverse actors and actants. In order to examine the ethical elements of these complex, relational encounters, students should be guided through reflective practices, which are carefully scaffolded in courses to develop students' mindfulness of their implication in a variety of becomings, whether that be of their own selves, of others' selves, or of engineering designs. Providing instructional strategies and appropriate assessments (e.g., reflective prompts) that encourage students to explore the complexity and fluidity of their own subjectivities and of the things they design may help students to recognize and articulate the power wielded by all things to which they must relate. Valuing the affective force of the differences they encounter calls each of them to select, with care, for the greatest possible diversity and complexity and to include that in whatever actualities they co-create. In sum, ethical becoming is making through caring and caring through making.

Acknowledgements This material is based upon work supported by the National Science Foundation under Grant No. 1737157. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

References

- Ash, S. L., & Clayton, P. H. (2009). Generating, deepening, and documenting learning: The power of critical reflection in applied learning. *Journal of Applied Learning in Higher Education*, 1(1), 25–48.
- Davis, M. (2006). Integrating ethics into technical courses: Micro-insertion. *Science and Engineering Ethics*, 12(4), 717–730.
- Deleuze, G. (1993). *The fold: Leibniz and the Baroque*. Minneapolis: University of Minnesota Press.
- Dewey, J. (1988). *The Middle works of John Dewey, Volume 12, 1899–1924: Reconstruction in philosophy and essays 1920*. Carbondale, IL: Southern Illinois University Press.
- Dewey, J. (1998). *Experience and education*. Indianapolis: Kappa Delta Pi.
- Faubion, J. D. (2001). Toward an anthropology of ethics: Foucault and the pedagogies of autopoiesis. *Representations*, 74(1), 83–104.
- Fore, G. A. (2013). Leading while being led: Developing the developer at a Catholic NGO in Cape Town. *Anthropology Southern Africa*, 36(1&2), 80–90.
- Foucault, M. (1997). *Ethics, subjectivity and truth: The essential works of Michel Foucault 1954–1984* (R. Hurley, Trans., Vol. 1).
- Harris, C. E. (2008). The good engineer: Giving virtue its due in engineering ethics. *Science and Engineering Ethics*, 14(2), 153.
- Hartshorne, C. (1970). *Creative synthesis and philosophic method*. La Salle, IL: Open Court.
- Henning, B. G. (2005). *The ethics of creativity: Beauty, morality, and nature in a processive cosmos*. Pittsburgh: University of Pittsburgh Press.
- Henning, B. G. (2008). Is there an ethics of creativity? In T. Walker & M. Toth (Eds.), *Whiteheadian ethics: Abstracts and papers from the ethics section of the philosophy group at the 6th international Whitehead conference at the University of Salzburg, July 2006*. Newcastle: Cambridge Scholars Publishing.
- Hess, J. L., & Fore, G. (2018). A systematic literature review of US engineering ethics interventions. *Science and Engineering Ethics*, 24(2), 551–583.
- Hess, J. L., Strobel, J., & Pan, R. (2016). Voices from the workplace: Practitioners' perspectives on the role of empathy and care within engineering. *Engineering Studies*, 8(3), 212–242.
- Ingold, T. (2013). *Making: Anthropology, archaeology, art and architecture*. Abingdon: Routledge.
- Latour, B. (2004). *Politics of nature*. Cambridge: Harvard University Press.
- Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge: Cambridge University Press.
- Nair, I., & Bulleit, W. M. (2019). Pragmatism and care in engineering ethics. *Science and Engineering Ethics*. <https://doi.org/10.1007/s11948-018-0080-y>.
- Nyamnjoh, F. B. (2017). *Drinking from the Cosmic Gourd: How Amos Tutuola can change our minds*. Bamenda: Langaa RPCIG.
- Pantazidou, M., & Nair, I. (1999). Ethic of care: Guiding principles for engineering teaching & practice. *Journal of Engineering Education*, 88(2), 205.
- Riley, D. (2013). Hidden in plain view: Feminists doing engineering ethics, engineers doing feminist ethics. *Science and Engineering Ethics*, 19(1), 189–206.
- Riley, D., & Lambrinidou, Y. (2015). Canons against cannons? Social justice and the engineering ethics imaginary. In *ASEE conferences, 2015* (Vol. 26).
- Schmidt, J. A. (2014). Changing the paradigm for engineering ethics. *Science and Engineering Ethics*, 20(4), 985–1010.
- Shaviro, S. (2012). *Without criteria: Kant, Whitehead, Deleuze, and aesthetics*. Cambridge: MIT Press.
- Sherburne, D. W. (1966). *A key to Whitehead's process and reality*. Bloomington: Indiana University Press.

- Stenner, P. (2008). AN Whitehead and subjectivity. *Subjectivity*, 22(1), 90–109.
- Tronto, J. C. (1993). *Moral boundaries: A political argument for an ethic of care*. London: Psychology Press.
- Wallack, F. B. (1980). *The epochal nature of process in Whitehead's metaphysics*. Albany: SUNY Press.
- Whitbeck, C. (2011). *Ethics in engineering practice and research* (2nd ed.). Cambridge: Cambridge University Press.
- Whitehead, A. N. (1934). *Nature and life* (Vol. 13). Cambridge: Cambridge University Press.
- Whitehead, A. N. (1967). *Adventures of ideas* (Vol. 2). New York: Simon and Schuster.
- Whitehead, A. N. (1968). *Modes of thought*. New York: The Free Press.
- Whitehead, A. N. (1978). *Process and reality*. Corrected edition, ed. David Ray Griffin and Donald W. Sherburne, 47, 277. New York: Free Press.

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.