



What is menstruation for? On the projectibility of functional predicates in menstruation research

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Abstract

In 1993, biologist Margie Profet captured the attention of the popular press with the publication of her radical thesis: menstruation has a function. Traditional theories, she claims, typically view menstruation as a functionless by-product of cyclic flux. The details of Profet's functional account are similarly radical: she argues that menstruation has been naturally selected to defend the female reproductive tract from sperm-borne pathogens. There are a number of weaknesses in Profet's evolutionary analysis. However, I focus on a set of pragmatic problems that arise prior to any details of her evolutionary account. In arguing for the importance of pragmatic considerations, I draw from the linguistic analyses of Nelson Goodman. I conclude that critical investigation of the evolutionary details of Profet's pathogen defense account will be more feasible if and when biologists more frequently feature the female system of pathogen defense in their inductive generalisations. The system needs to be better entrenched before its functional components, such as menstruation, can be thoroughly investigated.

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1. Introduction

In 1993, biologist Margie Profet captured the attention of the popular press with the publication of her controversial thesis: menstruation functions as a defense

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against pathogens transported by sperm (Profet, 1993).¹ There has been less response in scientific journals and what little there is has failed, I argue, to address adequately her main point (see Clarke, 1994; Finn, 1994; Strassmann, 1996). Profet hypothesises that as mammals fertilise internally, the females of all (or nearly all) mammalian species will show evidence of menstruation, whether overtly or covertly, because menstruation is necessary for clearing the female reproductive tract of sperm-borne pathogens. She predicts that if menstruation isn't universal in mammals, then the presence of menstruation in any given species will vary relative to the breeding patterns of the species—the more frequent the rate of intercourse per fertilization cycle, the more likely it is that menstruation will be present (Profet, 1993, p. 335). The pressures of natural selection, she argues, explain the presence of menstruation. She claims that traditional accounts fail to describe menstruation as functional because, prior to her work, no one had thought to perform an evolutionary analysis of menstruation (p. 336). The traditional account of menstruation as a preparation for the implantation of a newly fertilised egg is not a functional thesis, in her view; rather, it characterises menstruation as a 'nonfunctional by-product of reproductive cycling' (p. 336).

In support of her functional thesis, Profet reviews the microscopy evidence that pathogens are transported by sperm to the uterus (p. 341). These pathogens may originate in the vagina, in the cervix, or in the male reproductive system. She then describes an array of female defenses against sperm-transported pathogens in the vagina, cervix and uterus (pp. 342–343). Of course, she notes, the aggressiveness of this defense system must be balanced with the need to make sperm welcome for reproductive purposes. To accomplish this balance, female defenses are increased somewhat during, but especially after, periods of sexual receptivity, that is, during and after exposure to sperm and the accompanying pathogens (p. 342).

During and after sexual receptivity, the walls of the vagina become cornified or scale-like, 'hindering sexually transmitted pathogens from colonizing vaginal tissue' (p. 342). In the cervix, thick, acidic mucus accumulates to keep sperm and the accompanying pathogens from proceeding to the uterus. During sexual receptivity, this particular defense must be weak in order to allow sperm through to fertilize eggs, but before and especially after sexual receptivity this defense is particularly strong. Profet notes that the uterus and oviducts have similarly well timed defenses (pp. 343–344), and argues further that 'nonmenstrual forms of normal uterine bleeding', such as postpartum and periovulatory bleeding, also have an anti-pathogen function (pp. 348–350).

Concluding this section of her argument, she writes: 'the female reproductive organs have a cascade of defenses designed to protect them against sexually-transmitted pathogens. I propose that menstruation is one such defense' (p. 344).

Profet presents two methods by which menstruation serves its antipathogen func-

¹ See, for example, the articles in *The New York Times* (Angier, 1993), *Time* (Toufexis, 1993), *Newsweek* (Seligmann, 1993), *People* (Plummer, 1993), *Shape* (Amodio, 1994), *Glamour* (Glamour editorial staff, 1994), *New Scientist* (Mestel, 1993) and *Omni* (Rudavsky, 1994), all of which feature Profet as the 'maverick' scientist with the 'radical' thesis.

tion: first, mechanically; and second, immunologically (p. 345). In the mechanistic process, pathogens attached to the endometrium (uterine lining) are expelled as the endometrium is sloughed off. ‘Pockets of menstrual blood form hematomas at the base of the endometrium, which lift, stretch, and help to shed it’ (p. 345). In the immunological process, pathogens are fought with leukocytes. ‘Menstrual blood delivers large concentrations of leukocytes to bacteria-infested endometrial tissue. Leukocytes directly combat pathogens and also phagocytise [envelop] potentially infected necrotic tissue’ (p. 345).

Profet then anticipates and counters a possible problem with her thesis. Pathogens such as bacteria actually *require* iron to survive. It might seem unlikely, then, that an iron-rich substance such as menstrual blood has the function of *combatting* bacteria (p. 346). Profet responds with two arguments. The first is that the substance lactoferrin, which is found in both menstrual and circulatory blood, chemically sequesters the iron, making it unavailable to bacteria. Levels of lactoferrin in circulatory blood have been shown to increase prior to menstruation, and it is inferred that the levels are high in menstrual blood as well (p. 346). The second is that, during menstruation, iron levels are low in circulatory blood anyway. Again, it is inferred that these lower levels are mirrored in those of menstrual blood. She also notes that iron levels in menstrual blood might be *less* than those in circulatory blood, which would mean that the iron loss during menstruation, calculated by measuring circulatory levels, is over-estimated (p. 347).²

To review, Profet argues that female mammals have a variety of defenses to protect them from sperm-borne pathogens, and that menstruation is one such mechanism. Profet is, arguably, the first researcher to examine these individual mechanisms as part of a female defense *system*; certainly the first to provide a detailed evolutionary examination of the individual responses, and the system in which they play a part. Although the medical and biology journals have not focused much attention on her work, it would seem that Profet has described the function of menstruation in a way that newly synthesises a variety of immunological and physiological research previously thought to be unrelated. Such a project seems long overdue. Furthermore, Profet’s functional arguments about menstruation have potentially significant clinical implications. Menstrual blood is often seen as a contributing factor in uterine infections, so current clinical practice favours treating some uterine infections by artificially inhibiting menstruation. According to Profet, menstruation actually *combats* such infection. If she is right, inhibiting menstruation at these times is contraindicated. Current clinical practice, she says, ‘blames the firemen for the fire’.

However, it is one thing to argue that a particular mechanism can be thought of as currently ‘functioning’ in a particular way. Physiologists and clinicians make these sorts of functional claims all the time, with little or no interest in the evolutionary history of the mechanism in question. But it is much more difficult, both empirically

² Profet notes that the research on levels of both lactoferrin and iron typically assumes that the levels in circulatory blood will be the same as that found in menstrual blood, though these claims are not tested (Profet, 1993, p. 347).

and conceptually, to argue that a particular mechanism has been naturally selected *for* any given function. These difficulties are often used by physiologists and clinicians to support the claim that natural selection accounts are not necessary tools for studying disease mechanisms (Gammelgaard, 2000).³

Leaving aside debates about the place of evolutionary theory in current clinical practice, it is certainly the case that the weakest parts of Profet's project involve her natural selection account.⁴ She often conflates accounts of recent selection pressures within, say, proto-human ancestry with the selection pressures faced by mammals generally, as when she defends her functional thesis from a competing view that menstruation functions to decrease levels of iron that would otherwise lead to heart disease (Profet, 1993, p. 337). In her criticism of this competing thesis she abruptly switches the level of analysis from the ancestral selection pressures faced by early mammals to the more recent pressures faced by 'hunter-gatherer women, and by extension our Pleistocene ancestors'. She argues that these women would have no need to have their iron levels reduced, as they 'seldom lived long enough to suffer degenerative diseases of old-age' (*ibid.*, p. 337). However, one could just as easily use the selection pressures faced by these women to argue against Profet's thesis. Menstruation would be an unlikely aid to women who were usually pregnant during their reproductive years. These and other concerns with her evolutionary account are discussed further below.

Most of my discussion, however, focuses on a set of pragmatic concerns that, in the case of functional explanation, prove to be conceptually prior to questions of evolutionary detail. In the case of functional hypotheses, empirical attention often needs to be paid not just to the selection history of the mechanism in question, but also to the pragmatic details that underwrite our interest in and characterization of both the mechanism and the contribution of the mechanism to the working order of the larger system of which it is a part. The need for examining these pragmatic considerations becomes particularly obvious when the hypothesis is new or controversial as is the case with Profet's account.

Recall Profet's claim that the reason a functional account of menstruation has proven elusive is because biologists have failed to subject menstruation to an evolutionary analysis. Once the selection pressures on female mammals are made clear, she implies, the pathogen defense function of menstruation would be equally transparent. However, the cool reception of Profet's hypothesis by her peers suggests otherwise. I argue that pragmatic considerations such as those introduced by feminist studies of biology might better explain why Profet's arguments for menstruation sound so revolutionary and why her work has largely been ignored in the science literature.

³ Indeed if Profet is right about the current clinical importance of menstruation as a pathogen defense, many clinicians might be inclined to say that debates about the selection history of menstruation, while interesting, are entirely beside the point.

⁴ Though certainly, insofar as she argues that the selection history of menstruation is causally related to her clinical prescriptions for the treatment of uterine infection, any weaknesses in her evolutionary account similarly weaken her important clinical claims.

2. The etiological account and some pragmatic considerations

Profet's straightforward appeal to an evolutionary explanation of function is similar to what is called the 'etiological' viewpoint within philosophy of biology. According to the etiological account, evolutionary theory is the key to providing the distinction between functions and nonfunctions. To cite a favourite example in the etiologist literature, the function of the heart is to pump blood, because an evolutionary account reveals that the heart was naturally selected to pump blood. The heart was not selected to produce heartbeats, so noise production is a nonfunction, or a side-effect. Various versions of this etiological position are taken by philosophers such as Larry Wright, 1972, 1973), Ruth Millikan (1989), Karen Neander (1991) and Peter Godfrey-Smith (1994).⁵ According to this approach, a mechanism is functional in so far as it was selected to perform that function in the past. The term 'etiological' refers to the historical course of the functional mechanism's evolution by natural selection.

The functional analysis provided by philosophers such as Robert Cummins (1989), Christopher Boorse (1976) and Elizabeth Prior (1985) presents a set of pragmatic issues that can be seen as conceptually prior to the evolutionary analyses offered by the etiologists. These more pragmatic philosophers often support the view that the evolutionary course of a functional mechanism is an important aspect to study.⁶ However, they argue that we cannot arrive at this course by simply reading off the evolutionary facts of nature, independent of a contextual analysis of the goals of the larger system within which the mechanism in question is said to function. They agree with the etiologists that the heart functions to pump blood, and that a sophisticated adaptationist analysis can provide a good explanation of how the heart came to be functional in this way. But they add that using evolutionary theory to ascribe functional status to a mechanism is always relative to a number of pragmatic or second-order considerations about the systems within which that mechanism is situated. We must have individuated some features of an organism into 'functional' systems and mechanisms working within that system before we can begin to analyse the evolutionary history of the functional features. According to the more pragmatically inclined philosophers, functions are 'those effects of the components of [a] system reference to which provides us with our best account of some high-level capacity of that system' (Prior, 1985, p. 311).

A second-order analysis reveals a number of pragmatic variables that influence the focus of our interest in some systems rather than others. For example, Derek Turner has recently argued that biologists have trouble making functional ascriptions unless they have available a familiar functional analogue for the mechanism in ques-

⁵ Many of these essays have recently been anthologised in *Nature's Purposes: Analyses of Function and Design in Biology* (Allen, Bekoff, & Lauder, 1998).

⁶ Cummins is idiosyncratic in this regard, discussing functions in nonevolutionary contexts. However, his recognition of the importance of studying the capacities of containing systems fits well with the evolutionary functional analysis described by Boorse and Prior.

tion (Turner, 2001). If this is true then it is likely that human interests and cultural context will (and have) influenced what sort of analogues are available and salient.⁷

Nelson Goodman has written extensively on this process, using the term ‘entrenchment’ where I have used ‘human interest’ and ‘salience’. Goodman’s work focuses on the study of confirmation, specifically on difficulties in distinguishing between hypotheses that are confirmed by their instances and those that are not. The hypothesis that copper conducts electricity seems properly supported by instances of copper conducting electricity. That copper conducts electricity is a law-like generalisation, says Goodman. Compare this generalisation to the hypothesis that every man in my logic class is a third son. Here, the discovery that one of the male students was indeed a third son, would not increase the credibility of the hypothesis as it stands. This latter hypothesis, says Goodman, is accidental rather than lawlike.

How then to tell the difference? Traditional accounts of confirmation demand a decision algorithm based on objective features of the hypothesis in question; that is, an algorithm based on syntactical features. Goodman argued, convincingly, that non-syntactical features play more of a role in confirmation than was first supposed (Goodman, 1955, p. 73). Specifically, he showed that the predicates used in any given hypothesis must be well behaved, that is, ‘projectible’, before those hypotheses could be confirmed by their instances; projectibility, it turns out, is largely an issue of entrenchment in linguistic usage.

Goodman has a number of arguments to support his confidence in the positive correlation between linguistic descriptions and the world described (Goodman, 1955, 1978), though these arguments will not be a focus here. However, his confidence still leaves room for interesting questions about how the world is individuated through linguistic usage. Which systems of an organism strike us as functional? Which functional hypotheses are subsequently confirmed by evolutionary data about the natural selection of mechanisms within that system?

I argue that when attributing functional status to elements of a biological system, both the system and the capacities of that system can be viewed as predicates that need to be well entrenched in the appropriate linguistic sphere before functional hypotheses containing those predicates are themselves projectible and capable of empirical confirmation.

For example, within the biological study of the well entrenched circulatory system we have a number of components such as the heart, the veins and the arteries, all of which produce a number of different effects. Once a capacity of that system has been similarly entrenched, such as the capacity ‘circulates nutrients/disposes of wastes’, those effects of the components that contribute to our *explanations* of that capacity can be identified as functions, and the rest (such as production of heartbeats) as mere effects. In other words, the historical entrenchment of the capacity ‘circulates nutrients/disposes of wastes’ helped to decide which of any competing functional

⁷ See also Peter Machamer, Lindley Darden and Carl Craver, who argue that historical context is important for the intelligibility of various mechanisms employed within scientific explanations (Machamer, Darden, & Craver, 2001, p. 21).

hypotheses about hearts were later analysed using natural selection accounts of the circulatory system. The various components of the vertebrate circulatory system and their contribution to its circulatory capacities were well entrenched and well understood, even before natural selection accounts of the system were in place. The high frequency of the use of the capacity predicate ‘circulates nutrients’ (or a nearly co-extensive term such as ‘pumps blood’) positively influenced the projectibility of the functional hypothesis ‘the heart functions to pump blood’ in later selection accounts.⁸ Given that no other capacities of the system have been entrenched, no evolutionary story can be told that would ascribe to the heart a function other than pumping blood. The production of heartbeats, for example, is properly described as a side-effect of the functioning of the heart (see Fig. 1).

Imagine, though, that heart sounds and stethoscope technology evolve together over the next few millennia with the effect that cardiac diagnostic accuracy is markedly increased. It might then be possible to give an etiological account detailing the selective pressures on the production of heart sounds. However, if Goodman is right about projectibility, then some system *other* than that of vertebrate circulation would have to become entrenched before heartbeat production could be given an adaptationist account; that is, before heartbeat production could become a projectible function of the heart.

Returning to Profet’s functional hypothesis, I argue that testing the evolutionary hypothesis ‘menstruation functions to remove pathogens transported by sperm’ will be more feasible if and when the predicates involved in the hypothesis become more projectible.

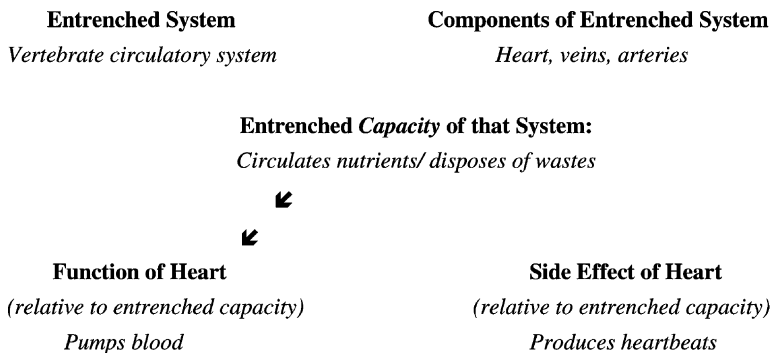


Fig. 1. Function of heart relative to capacity for circulation.

⁸ Goodman explains that the co-extensions of a predicate are equally projectible, even if they are not as familiar to us. Projectibility cannot be reduced to mere familiarity—unfamiliar predicates might become projectible (Goodman, 1955, pp. 95–96).

3. ‘The physiology of menstruation shows adaptive design’

Unencumbered by the pragmatic details of projectibility, Profet’s argument focuses on explaining the presence of menstruation by showing that menstruation was naturally selected to perform its function of removing sperm-transported pathogens. Profet cites George Williams’ two-part investigation for identifying whether a process is a functional mechanism in the etiological sense (Williams, 1966; cited in Profet, 1993, p. 336). The first part of the investigation involves ‘identifying the problem that the candidate mechanism was designed to solve’. (Here, questions of projectibility could certainly make an appearance, although I will show that they enter even earlier.) The second part of the investigation involves ‘elucidat[ing] design—that is, show[ing] that there is an adaptive fit between the mechanism and the problem that is too close to be merely the product of chance or the by-product of other mechanisms’ (Profet, 1993, p. 336).⁹

To satisfy the first part, Profet itemises a number of candidate problems, besides her own preferred one, that menstruation may have been designed to solve. One such problem is the build-up of plant toxins in the uterus. Menstruation might remove these toxins. Another is the strain on the cardiovascular system that results from high iron levels. Again, iron loss through menstruation might be thought to keep these levels healthy (*ibid.*, p. 337).

She then continues with the second part of her investigation by illustrating how menstruation as a defense against pathogens shows an adaptive fit that is not found with menstruation as a removal of plant toxins or as a reduction of iron. She argues that natural selection cannot explain these other competing options. In the case of plant toxins, she points out that they can be removed without endometrial breakdown. It is in her arguments against the selection of menstruation for iron reduction that she switches the burden of proof from the selection pressures faced by ancestral mammals to pressures faced more recently by proto-humans. Accordingly she argues that our proto-human ancestors ‘rarely live[d] long enough to suffer degenerative diseases of old age’ such as heart disease (p. 337), which would make iron reduction an unlikely functional candidate.

In arguing that menstruation as a pathogen defense shows an adaptive fit ‘too close to be merely the product of chance’, Profet points out that menstruation *must* be an adaptation (i.e. it must be a functional mechanism) because it is too costly to have lasted unless it also offered some selective advantage (p. 337). ‘If menstruation were both costly and functionless, natural selection surely would have eliminated it long ago’ (p. 336). According to Profet, menstruation is costly both nutritionally (through iron and tissue loss) and reproductively (through the reduction of the number of reproductive opportunities in any one breeding season). Further, the uterus wall is lined with specialised spiral-shaped arteries ‘that constrict and dilate in a

⁹ Williams’s own account offers an iterative process for recognising adaptations prior to this two-step process. Contemporary accounts would require an even more stringent set of criteria (see Pigliucci & Kaplan, 2000).

sequence timed to induce menstruation’ (p. 339). Finally, menstrual blood differs from circulatory blood such that in menstrual blood, clotting is reduced (p. 339). Profet believes that this efficient, precise and complex system points to adaptation. She writes: ‘If menstruation were merely a functionless by-product of cyclic hormonal flux [i.e., if menstruation were not naturally selected], there would be no mechanisms [the spiral arteries] specifically designed to cause it, nor would the constituents of menstrual and [circulatory] blood differ significantly [such that circulatory blood clots but menstrual blood does not]’ (p. 338).

4. The etiology of menstruation as a pathogen defense: some concerns

On Profet’s account, if menstruation were both costly and functionless, natural selection would have eliminated it long ago. Menstruation *is* costly. Menstruation has not been eliminated. Therefore menstruation has a function (i.e., it has been naturally selected). In specifying the *exact* function, Profet argues that pathogen defense is the only functional hypothesis that can explain the presence of menstruation. That menstruation has the function of removing sperm-transported pathogens explains the presence of menstruation (and the requisite physiology such as spiral arteries and low levels of coagulant).

There are numerous problems with the inferences she makes here. As Hempel has argued, identifying a problem to be solved—in this case, combatting sperm-borne pathogens—does not countenance an inference to any *particular* functional solution (Hempel, 1965). Indeed, Profet’s description of the defense system of the female reproductive tract includes a number of other components such as vaginal cornification, mucous plugs in the cervix, and nonmenstrual bleeding in the uterus, any or all of which could be solutions to the problem of sperm-borne pathogens. Knowing there is a problem to be solved does not guarantee that a particular solution will be selected in any given case.¹⁰ At most Profet can infer some general sort of defense mechanism, with the built-in redundancy of the functional equivalents, but she cannot, at this point, infer menstruation in particular.

As mentioned earlier, Profet also neglects the evolutionary details necessary to move from the ancestral selection pressures faced by all mammals to the more recent pressures faced by proto-humans. Unless she wants to claim that every mammal species evolved menstruation independently, she needs the ancestral account to support her claims about the universality of menstruation in mammals. But she also needs the more recent-selection account to support her clinical prescriptions for treating uterine infection in contemporary human females. Details of both accounts and the historical links between them are lacking.

It could be possible, for example, that pathogen defense is a ‘piggy-back’ trait that has no selection history except through its close connection with another trait

¹⁰ This point is argued further in Matthew Ratcliffe’s essay ‘Cognitive Adaptation and Truth’ (Ratcliffe, 2001).

that has itself been selected.¹¹ Pathogen defense might also be a result of what Paul Griffiths calls ‘exadaptation’, where a mechanism originally selected for one function comes to have another (Griffiths, 1992). These questions require far more examination than Profet provides.

However, in addition to the incredibly difficult evolutionary questions that confront Profet’s project, there is also the lack of entrenchment of the containing system within which her functional account of menstruation is situated—viz., the distinctively female system of sperm-borne pathogen defense.

5. A pragmatic prescription

The more pragmatic, contextual approach of Cummins and others helps to address these second-order, contextual questions. Cummins argues that, typically, we don’t appeal to functions in order to explain the presence of the mechanism in question; rather, we appeal to functions in order to explain the capacities of some ‘containing system’, whether that system be an organism, a system of organisms, or a system within an organism (Cummins, 1989, p. 501). In Goodman’s terms, the containing system predicate needs to be entrenched, as do predicates or categories of the system’s capacities, before an evolutionary account can be given. The containing system of Profet’s functional account is the female reproductive tract, which is itself well entrenched. But what about Profet’s hypothesised capacity of that system—the capacity of defense against sperm-borne pathogens? How well is this capacity entrenched in contemporary evolutionary biology? How often has this capacity been used in making inductive generalisations? An examination of the literature indicates not well, and not often (see Fig. 2).

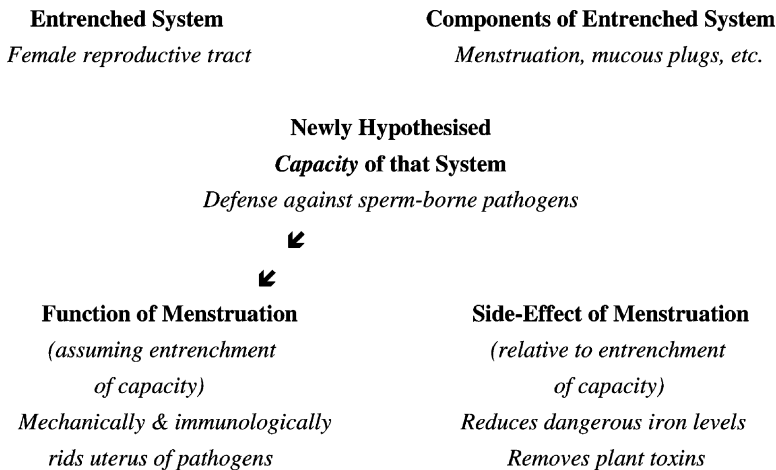


Fig. 2. Function of menstruation relative to capacity for pathogen defenses.

¹¹ For more on ‘piggy-back’ traits see Neander (1991), pp. 179–180.

According to the pragmatic, contextual considerations outlined above, there are three levels of ‘interest’ or entrenchment required to get a functional account projected and subsequently tested, and Profet’s account is missing two. The first element is some established research interest in a particular containing system. In Profet’s example, this is the system of the female reproductive tract, and this system is well entrenched. The second is the entrenchment of a capacity of the containing system; that is, the capacity, or some extensional equivalent, has to have appeared in a sufficiently large number of hypotheses in evolutionary biology. In Profet’s case, this would mean established research interest in the capacity of the female reproductive tract to defend itself against sperm-borne pathogens. The third element is some understanding of how individual components of that system contribute to our explanations of the capacities of that system. For Profet, this would involve projectible hypotheses about the role of menstruation in the healthy operation of the sperm-borne pathogen defense system. These last two elements are currently absent in Profet’s case—hypotheses containing the predicates ‘defends the female against sperm-borne pathogens’ are not currently projectible. As Profet laments, there has been little established research interest in the sperm-borne pathogen defense system of the female reproductive tract, and as a consequence there is little understanding of how the components of that system work together.

However, Profet also argues that the reason we don’t think of menstruation as functional is simply because we have never viewed menstruation from an evolutionary perspective. There are two potential issues of contention here. The first has been mentioned earlier, and concerns the debate between those who argue that we should expand the etiological approach to better understand functional claims in physiology and medicine, and those who argue that we should continue to keep evolutionary explanations separate from functional claims in physiology and medicine, indeed, that in these latter spheres, evolutionary etiology is often beside the point. Williams and Randolph Nesse have championed the former position, as documented in their book *Evolution and Healing: The New Science of Darwinian Medicine* (Nesse & Williams, 1995), and Profet is clearly supportive of their cause. She argues that understanding the selected function of menstruation ‘is essential for making good [clinical] decisions about whether and when to interfere with menstruation (Profet, 1993, p. 368). Against Williams and Nesse, Anne Gammelgaard and a number of physiologists have argued that etiological/natural selection accounts are not necessary tools for physiologists and others who study disease mechanisms (Gammelgaard, 2000). Unlike Profet, some etiologists have accepted this sort of boundary setting, admitting that an etiological account of functions might be better suited to evolutionary biology than it is to medicine and physiology.¹²

Whether Profet will find herself on the winning side of this particular issue is an empirical question, though there are no signs that it will be decided any time soon. As I have noted, however, a second point of contention remains. When Profet argues

¹² This more pluralist account of functions is discussed by Philip Kitcher (1993) and David Buller (1998).

that the function of menstruation will be clear once we take an evolutionary perspective, she fails to consider that, in this case in particular, there are a number of second-order concerns about the larger system within which her menstruation hypothesis is contained. A quick examination of Beverly Strassman's response to Profet is illustrative of the problem here (Strassman, 1996). Strassman's is the only substantial response to Profet's thesis published to date. She follows up Profet's study with an explicitly evolutionary analysis of menstruation, as Profet prescribes. She concludes, however, that menstruation is not itself functional; that it is a by-product of the highly functional endometrial shut-down that occurs during periods of non-sexual receptivity. Interestingly, Strassman spends only 1/2 of a page of her 32 pages of text considering the role of menstruation in any larger system of female pathogen defense. And here she looks only at Profet's claims about the sperm barrier provided by cervical mucous—no other aspects of the system are discussed. The female pathogen defense system that forms the larger context of Profet's thesis is not given any significant treatment; i.e., it does not seem particularly projectible, or salient, as far as Strassman is concerned.¹³

Here, then, is a site for a pragmatic examination of how second-order contextual issues inform what can come under the purview of etiological functional analysis. In this case we might not be surprised to discover that a particular kind of masculine bias has informed the choice about which physiological systems and capacities of those systems are salient and entrenched. A number of compelling feminist studies of biology provide significant grist for the mill here (see, for example, *Myths of Gender: Biological Theories of Women and Men*, by Anne Fausto-Sterling, 1992). While there has been no feminist analysis of this particular issue, it does not seem overly provocative to suggest that certain strains of androcentrism may have negatively influenced the amount of research directed at the female system of sperm-borne pathogen defense.

In this respect it is interesting to compare the lack of entrenchment of Profet's functional thesis, and the female defense capacity to which it is hypothesised to contribute, with another more thoroughly entrenched account—*viz.*, the view that menstruation prepares the womb for the implantation of a fertilised egg. *Pace* Strassman and Profet, this latter account can still be, and often is, thought of as a functional account. And unlike Profet's account, it fits within the well established, well researched system of the female reproductive tract. In Goodman's terms, the predicate 'prepares the uterus for the implantation of a new egg' is an 'old-timer' well entrenched in the linguistic conventions of physiologists, mostly through its relation to the well entrenched capacity predicate 'pregnancy'—a capacity that we are likely to associate with female reproduction (see Fig. 3).

Again, a pragmatic, contextual analysis points us in directions of inquiry that are not quite so obvious when attending simply to the details of the etiological account.

¹³ A helpful discussion of the Profet/Strassman debate can be found in Angier (2000), though, tellingly, Angier downplays the larger context of the female pathogen defense system once the discussion moves to Strassman (Angier, 2000, pp. 109–116).

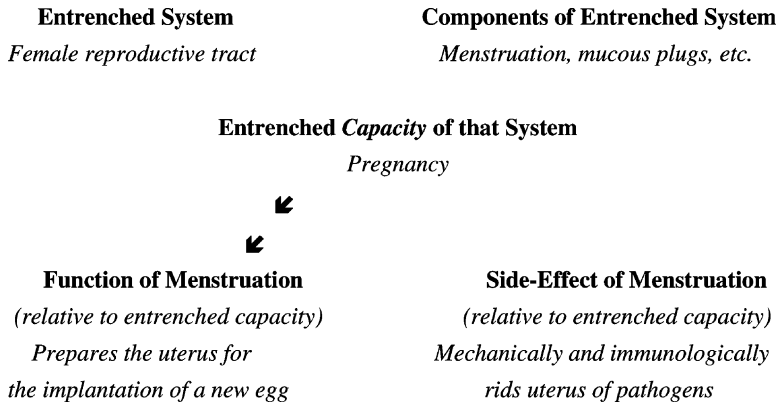


Fig. 3. Function of menstruation relative to capacity for pregnancy.

Examinations of the historical context of particular sorts of masculine bias in biology and physiology (as elsewhere) might help to answer the question of how the pregnancy predicate came to be of interest; that is, of how it came to be entrenched in physiology and evolutionary biology, while the sperm-borne pathogen defense predicate did not. Indeed, whenever a functional claim involves controversial ideas that capture public attention, a second-order analysis of the entrenchment of the system within which that function is situated is bound to be revealing.

In Profet's particular case, it seems clear that feminist studies of sexism in science provide good *prima facie* support for further examination of her functional hypothesis. It is only through an increase in the frequency with which we use the predicate 'protects females from sperm-transported pathogens' that her functional hypothesis can become projectible and tested against evolutionary data about menstruation.

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References

- Allen, C., Bekoff, M., & Lauder, G. (Eds.). (1998). *Nature's purposes: Analyses of function and design in biology*. Cambridge, MA: M.I.T. Press.
- Amodio, J. (1994). Profet-ing from a dream. *Shape*, 13(6), 29.
- Angier, N. (1993). Radical new view of role of menstruation. *New York Times*, Sept. 21, Section B, 5–6.
- Angier, N. (2000). *Woman: An intimate geography*. New York: Anchor Books.
- Buller, D. (1998). Etiological theories of function: A geographical survey. *Biology and Philosophy*, 13, 505–527.
- Boorse, C. (1976). Wright on functions. *Philosophical Review*, 85, 70–86.

- Clarke, J. (1994). The meaning of menstruation in the elimination of abnormal embryos. *Human Reproduction*, 9, 1204–1207.
- Cummins, R. (1989). Functional analysis. In B. A. Brody, & R. E. Grandy (Eds.), *Readings in the philosophy of science* (2nd ed) (pp. 495–511). Englewood Cliffs: Prentice Hall. Originally published 1975.
- Fausto-Sterling, A. (1992). *Myths of gender: Biological theories about women and men* (2nd ed). New York: Basic Books. Originally published 1985.
- Finn, C. A. (1994). The meaning of menstruation. *Human Reproduction*, 9, 1202–1203.
- Gammelgaard, A. (2000). Evolutionary biology and the concept of disease. *Medicine, Health Care and Philosophy*, 3, 109–116.
- Glamour editorial staff (1994). The important questions one woman asked. *Glamour*, 92(1), 47.
- Godfrey-Smith, P. (1994). A modern history theory of functions. *Nous*, 28(3), 344–362.
- Goodman, N. (1955). *Fact, fiction and forecast* (2nd ed.). Indianapolis: The Bobbs-Merrill Company, Inc.
- Goodman, N. (1978). *Ways of worldmaking*. Indianapolis: Hackett Publishing, Inc.
- Griffiths, P. (1992). Adaptive explanation and the concept of a vestige. In P. Griffiths (Ed.), *Trees of life* (pp. 111–132). Dordrecht: Kluwer.
- Hempel, C. G. (1965). *Aspects of scientific explanation and other essays in the philosophy of science*. New York: The Free Press.
- Kitcher, P. (1993). Function and design. *Midwest Studies in Philosophy*, 28, 379–397.
- Machamer, P., Darden, L., & Craver, C. (2001). Thinking about mechanisms. *Philosophy of Science*, 67(1), 1–25.
- Mestel, R. (1993). Are periods a protection against men? *New Scientist*, 140, 1893.
- Millikan, R. G. (1989). In defense of proper functions. *Philosophy of Science*, 56, 288–302.
- Neander, K. (1991). Functions as selected effects: The conceptual analyst's defense. *Philosophy of Science*, 58, 168–184.
- Nesse, R., & Williams, G. C. (1995). *Evolution and healing: The new science of Darwinian medicine*. London: Phoenix.
- Pigliucci, M., & Kaplan, J. (2000). The fall and rise of Dr. Pangloss: Adaptationism and the Spandrels paper 20 years later. *Trends in Ecology and Evolution*, 15(2), 66–70.
- Plummer, W. (1993). A curse no more. *People Weekly*, 40(15), Oct. 11, 75.
- Prior, E. (1985). What is wrong with etiological accounts of biological function? *Pacific Philosophical Quarterly*, 66, 310–328.
- Profet, M. (1993). Menstruation as a defense against pathogens transported by sperm. *The Quarterly Review of Biology*, 68(3), 335–386.
- Ratcliffe, M. (2001). Cognitive adaptation and truth: A sceptical view. Paper presented at the International Society for History, Philosophy and Social Studies of Biology, Quinnipiac University, Connecticut, July 19.
- Rudavsky, S. (1994). Interview with Margie Profet. *Omni*, 16(8), May, 69.
- Seligmann, J. (1993). Rethinking women's bodies. *Newsweek*, 122(14), Oct. 4, 86.
- Strassmann, B. (1996). The evolution of endometrial cycles and menstruation. *The Quarterly Review of Biology*, 71(2), 181–220.
- Toufexis, A. (1993). A woman's best defense? *Time*, 142(14), Oct. 4, 72.
- Turner, D. (2001). The role of analogy in reverse engineering. Paper presented at the International Society for History, Philosophy and Social Studies of Biology, Quinnipiac University, Connecticut, July 21.
- Williams, G. C. (1966). *Adaptation and natural selection: A critique of some current evolutionary thought*. Princeton: Princeton University Press.
- Wright, L. (1972). Explanation and teleology. *Philosophy of Science*, 39(2), 204–218.
- Wright, L. (1973). Functions. *Philosophical Review*, 82, 139–168.