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# Design Analysis Suggests That Our "Immune" System Is Better Understood as a Microbe Interface System

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## Abstract

The immune system is often regarded only as a defense, keeping us free from harmful microbes. What if our immune system today is functioning not very differently than it did in the pre-Fall world? A better understanding of its purpose may emerge if we reframe it (1) via design-based system analysis, and (2) in light of contemporary microbiome research findings. Microbiome research reveals far more harmony than antagonism in organism-microbiome relationships. Systems analysis indicates one design certainty: an interface system must coordinate independent entities to harmonize together. Therefore, design-based creationist research would look for, and find, human-designed interface systems possessing nearly indistinguishable counterpart elements as found in immune systems. When dynamic host system-to-microbe relationships are understood in light of design analysis, the clear properties of a rich, multifunctional "microbe interface system" (MIS) are evident—which is the key link associating us to trillions of microbes in a mutually beneficial symbiotic relationship. Concentrating on the presence of interface-distinctive elements could better characterize what may misleadingly be labeled an "immune" system.

## Introduction

Microbial colonization of hosts is increasingly recognized as a mutually beneficial relationship that is critical for life in humans and many animals. Colonization on and within hosts is extensive, but the gut is a primary target of research. For instance, gut luminal cells help regulate the composition of microbiota (Salzman, 2010). In turn, gut microbiota can be vital in host metabolism, development, immunity, socialization, and well-being; imbalance may be associated with infections, and may also be associated with other diseases like obesity (Breton et al., 2016; Belkaid and Naik, 2013; Hooper et al., 2012; McFall-Ngai, 2012; Koren et al., 2011; An et al. 2014; Smith et al., 2013; Tremaroli and Backhed, 2012; Yong, 2015; Turnbaugh et al., 2009).

We began by questioning the whole notion of seeing immune systems as as-

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semblies for "defensive" purposes. This introduction details some reasons and assumptions prompting the reconsideration of something so firmly believed. First, voluminous new findings of extreme host-microbe mutualism need to be addressed. New discoveries of mutual microbe-host control (Maron, 2016) only make sense if Adam *had to* relate to his microbiota since his creation. Joseph Francis was an early creationist advocate of the nonadversarial host-microbe relationship, and has recently expanded his views (Francis, 2003, 2013). His pioneering approach applied Scripture to microbiology. His concepts have been overwhelmingly confirmed by research institutions worldwide. Other creationists have advocated for some nondefensive pre-Fall immunological functions. For example, Gillen and Conrad (2014) state: "Although no one knows for sure, it seems the immune system would be useful to the body even in a perfect world, because without an immune system and its components such as macrophages, the body would not be able to cleanse itself of worn-out blood cells."

Should deep-rooted thinking about the "immune" (meaning "to be free" or "exempt") system change? The whole idea of defensive immunity harkens back to conflict, as one researcher summarized: "For some, learning about our gut microbiomes brings back childhood memories … we saw our relationship with microbes portrayed in warlike, rather than in mutually beneficial, terms" (Gordon, 2012, p. 1251). Thus, a better explanation for host-microbe relationships could start with the "very good" creation perspective.

Since the origin and purpose of a system seem to be logically intertwined, we not only wanted to wholly reject the view that current host-microbe relations were produced through a death-driven, survival-of-the-fittest process, but we wanted to replace that approach with the Romans 1 alternative: intelligent design. This starts by asking a question: How would a human engineer *de-novo* solve problems to facilitate host-microbe interrelationships?

Creationist biologists, and not exclusively engineers, should ask this question. This assumes that if God's designs are "clearly seen" to humans regardless of culture or era, then His design characteristics must be analogous to the design characteristics of things humans have built or could build. We should be able to make a reasonable inference that living things are designed since their underlying principles and elements match so well with human-designed things. Thus, per Romans 1, people need neither a special "key" to understand God's designs, nor are they beyond the capability for humans to decipher them—though some deciphering comes only after considerable effort. Not speaking of life itself, but strictly in terms of function, we cannot think of any areas where the potential for human-contrived elements analogous to God's are not theoretically possible. It is likely that God is pleased when humans copy His designs into useful human technologies; and He is honored—provided that He is credited. It is also likely that God is glorified, not by "stumping" human researchers, but, rather, by the fact that they can discover *ad infinitum* elements of systems that display His great engineering genius.

We see entities work together all the time and rarely consider a profound design reality: that two autonomous entities will never spontaneously work together. Some bridging mechanism is a design absolute. Human engineers get distinct human and microbe systems to interact effectively by connecting them via an interface system. We are not referring to either what happens at the host-microbe contact surface, i.e., *an* interface (Shanahan, 2002), or a "social" interface (Muraille, 2013), but to something analogous to what human engineers would devise: a vital- regulatory-communication system pervasive to the organism, functioning to facilitate harmonious "requestor-provider" exchanges of information and products between entities. Could God have used something similar to facilitate harmonious host-microbe relationships?

If God did design interface systems into hosts and microbes, then it is reasonable that their harmonious operation would greatly exceed anything humans have devised. The host-microbe relationship could be so tight—so "seamless"—that it could be easily overlooked by researchers (as discussed below) that there remain two autonomous, barrier-bounded, distinct entities.

By way of overview, we will first briefly explain (1) how humans are extensively colonized with microbes and (2) what evolutionists believe for why host-microbe mutualism exists. We will then identify the interface-distinguishing elements within human-engineered interface systems. Then we will determine if immune systems have those distinguishing elements and if they function in a manner like human interfaces. We will conclude with several implications for the creationist model if the hypothesis of microbe interface systems in organisms is true.

## Colonization with Microbiota in Humans

Today we know that humans cannot live without microbes. It seems likely, then, that Adam's system was *vitally* important—even at a time when he was not subject to disease and death. Some background on the microbiota explains why a human-microbe interface system is an organism-wide necessity.

Humans are primarily colonized with microbes from their mother at birth and with continued skin-to-skin contact. When comparing formula-fed and breast-fed neonates, there is a marked difference in the composition of gut microbiota, and "the nutritional composition of breast-milk as compared to formula milk is believed to be a key determinant to this end" (Martin et al., 2009, p. 2090). Crucial gut microbiota become established within 2–3 years (Ray, 2012).

It was thought that the placenta, uterus, and gastrointestinal tract of a normal fetus was sterile *in utero* followed by rapid colonization with microbes after birth (Martin et al., 2009). Colonization from external sources may be the predominant mechanism, but studies have shown that the womb is in fact not sterile. The placenta harbors a distinct microbiome and appears to be seeding the fetal gut while in the womb (Collins, 2014).

The composition of placental microbes is neither static throughout pregnancy nor identical from mother to mother. Neonates weighing less than 1200 grams, or babies born less than 37 weeks gestation, are usually dominated by both *Firmicutes* and *Tenericutes* phyla, with fewer numbers of *Actinobacteria*. The full-term neonatal is "largely colonized by the phyla *Actinobacteria* (including *Bifidobacterium*), *Proteobacteria*, *Bacteroides*, and, much less, *Firmicutes* (including the *Lactobacillus* spp.), which dominate the vaginal flora" (Aagaard et al., 2014, p. 1).

By any estimate, the number of microbes cohabitating with humans is enormous. The commensal intestinal bacteria alone attain densities of $10^{12}$ organisms per ml of luminal contents (Mackie et al., 1999). "There are about 1000 species present, mostly anaerobes, but less than half of these species can be successfully cultured *ex vivo*. This immense load of commensal bacteria means that the number of bacterial cells being carried in the intestine is greater than the number of eukaryotic cells of the host's own body" (Macpherson et al., 2005, p. 153). That assessment appears to be in line with the most recent estimates.

The ratio of microbe-to-human cells has been revised downward. "Human bodies don't contain 10 times as many bacteria as human cells, new calculations suggest. A 'standard man' weighing 70 kilograms has roughly the same number of bacteria and human cells in his body…. This average guy would be composed of about 40 trillion bacteria and 30 trillion human cells, calculate researchers at the Weizmann Institute of Science in Rehovot, Israel…. Scientists who study the microbiome … have peppered research papers with an estimate that bacteria outnumber human cells 10-to-1 or even 100-to-1…. Judah Rosner, a molecular biologist … called the 10-to-1 ratio a 'fake fact' in a 2014 issue of *Microbe*. It probably wormed its way into scientific literature because it sounds good, Rosner says" (Saey, 2016).

The sheer numbers and types of microbes anticipates an immense impact of mutual host-microbe relationships. They affect the host at the most basic levels right from birth. For instance, in animals removed by c-section and maintained in a germ-free environment, immunological development in the gut mucosa is hypoplastic. But after commensal bacteria are introduced, the majority of the all the body's leucocytes are in the intestine (Macpherson et al., 2005). McFall-Ngai's research indicates that maintenance by vertebrates of gut microbiota, both throughout life and across generations, aids in a more efficient digestion not obtainable by invertebrates (McFall-Ngai, 2012).

What about Adam's microbiota? It is reasonable that Adam was created with a fully functional microbe interface system enabling him to relate to communities of microbes. God ensured that the necessary collection of gut microbes were in him at his creation. Eve possibly obtained her microbiome from Adam. It is probable that Adam's flora was more diverse than most urbanized people today. Samples of oral, skin, and fecal flora from Yanonami villagers of isolated Amazon tribes and rural people groups in Papua New Guinea demonstrate the most diverse gut bacteria yet documented in humans. Compared to US populations, most bacterial species are identified in both groups, but abundance profiles differ vastly, and tribespeople harbored numerous strains undetectable in US populations. The ratios of different species in US populations were more individualized (Martinez et al., 2015). The genetic diversity in fecal and oral bacteria in isolated populations compared to US residents was nearly double. Remarkably, gut bacteria carried genes conferring antibiotic resistance for drugs to which these tribespeople had no known exposures (Clemente et al., 2015).

## Evolutionary Origination of Host-Microbe Symbiosis

Evolutionary biologists believe that the very tight symbiotic relationships between autonomous organisms emerged through coevolution (see Box 1). Even vital host-microbe symbiosis arose through an iterative fortuitous selection for ever more specific mechanisms. "Humans and their microbiomes have coevolved as a physiologic community composed of distinct body site niches with metabolic and antigenic diversity," which Aagaard claims happened over untold generations: "Over the past 4 million or so years, hominids have coevolved with their microbiomes as physiologic communities composed of distinct body site niches" (Aagaard et al., 2014, p. 1). Coevolution extends beyond the individual as gut microbiota of infants are "ecologically engineered" by mother's breast milk: "An opportunity to gain insights into how natural selection has shaped the coevolution of hosts and microbes can be found in mammalian mother-infant dyads, as our microbiota are ecologically engineered by mothers and breastmilk" (Hinde and Lewis, 2015, p. 1427).

"Coevolution" as a scientific explanation satisfies no more observational

## Box 1: "Coevolved" Is Code for an Interface

Secular scientists maintain the complex microbiome and immune system evolved through vast eons of evolutionary time.

> We also need to think deeply about the evolutionary significance of our gut communities, for example, in the context of the origins and functions of our innate and adaptive immune systems. (Gordon, 2012)
>
> Shaped by millennia of evolution, some host–bacterial associations have developed into beneficial relationships, creating an environment for mutualism. (Round and Mazmanian, 2009, p. 313)
>
> In this Review, we discuss recent evidence suggesting that a beneficial partnership has evolved between symbiotic bacteria and the immune system. (Round and Mazmanian, 2009, p. 313)

In addition, evolution is animated to the point that it can create both molecules and unique mechanisms, establish relationships, and forge alliances.

> Nevertheless, current evidence supports that idea that certain beneficial bacteria have evolved molecules (known as symbiosis factors) that induce protective intestinal immune responses. (Round and Mazmanian, 2009, p. 320)
>
> An evolutionary alliance has been forged between mammals and beneficial bacteria that is crucial for maintaining the long-term survival of both. (Round and Mazmanian, 2009, p. 315)
>
> Bacterial pathogens have evolved a number of unique mechanisms to target and manipulate host cell signaling. (Sreelatha et al., 2013, p. 11563)
>
> The existence of this mutualism, established by evolution on both sides, has been long appreciated, but we are only beginning to understand the complex ways in which host and bacteria each adapt to the other's presence. (Macpherson et al., 2005, p. 153)

In their attempt to explain the origin of the human-microbe relationship a substantial ad hoc appeal is made to co-evolution—the supposed complementary evolution of two or more species and the sophisticated mechanisms they contain.

> Our microbial partners have coevolved with us to forge mutually beneficial (symbiotic) relationships. (Backhed et al., 2004, p. 15723)
>
> All coelomate vertebrates and invertebrates have coevolved with symbiotic gut microbes that perform multiple digestive and metabolic functions for the host.... The nature of the gut microbiome-host interactions seems such that the host controls the microbiome community structure, a process that has evolved to attain specific benefits ranging from protection to nutrition to physiology. (Martin et al., 2009, p. 2090)
>
> An animal's normal microbiota suggest that the presence of complex communities of coevolved bacteria is a shared feature among vertebrates. In general, the coevolved partnerships of invertebrates seem to be much less diverse. ... These coevolved, resident communities are often in direct contact with our tissues, are relatively resistant to perturbations, such as starvation, and provide us with the metabolic benefit of millions of additional genes and activities. ... Careful characterization of the gut microbiota of various vertebrates and invertebrates could address the basic premise that all vertebrates have a coevolved microbiota, whereas invertebrates rarely do. Similarly, comparative physiology could test the prediction that maintenance by vertebrates of coevolved microbial consortia, both throughout life and across generations, provides advantages, such as more efficient digestion, that are not available to invertebrates. (McFall-Ngai, 2012, p. 153)
>
> Millions of years of coevolution have molded this human-microbe interaction into a symbiotic relationship in which gut bacteria make essential contributions to human nutrient metabolism and in return occupy a nutrient-rich environment. (Vaishnava et al., 2008, p. 20858)
>
> Although this mutualism can break down in individuals with inflammatory bowel disease, coevolution of commensals and their hosts has ensured that inflammatory intestinal immunopathology is relatively rare. … it is likely that the commensals have coevolved with their hosts not to do this [subvert host control systems]. (Macpherson and Uhr, 2004, p. 1665)

Coevolution is *not* a scientific explanation and does nothing to elucidate sophisticated mutual or symbiotic relationships. Furthermore, appealing to ethereal "selective pressures" and peppering explanations with "just-so" descriptions reveals the naive nature of evolution.

> Our findings that the human gut microbiome can rapidly switch between herbivorous and carnivorous functional profiles may reflect past selective pressures during human evolution. Consumption of animal foods by our ancestors was probably volatile, depending on season and stochastic foraging success, with readily available plant foods offering a fallback source of calories and nutrients. Microbial communities that could quickly, and appropriately, shift their functional repertoire in response to diet change would have subsequently enhanced human dietary flexibility. Examples of this flexibility may persist today in the form of the wide diversity of modern human diets. (David et al., 2014, p. 561)

criteria than, for example, claiming that similar traits exist in two diverse creatures as being due to "convergent evolution." Coevolution is an *ad hoc*, after-the-fact explanation of present processes or conditions observed in nature.

There clearly seems to be some type of overriding logical information controlling the interrelationships of these different creatures. It may turn out that it is not located in either host or microbe DNA. But that would not rule out that it does not exist. The conundrum for explaining the origin of this information becomes even sharper below.

## Microbe Interface System: A Design-based Explanation of Host-Microbe Associations

Research programs begin with identifying a phenomenon that needs to be explained such as the behaviors in symbiotic relationships between different organisms. However, recognizing a relationship happens is far from explaining the mechanisms enabling that relationship to happen. *This is a fundamental question at the foundations of biology: How do two autonomous entities with distinct boundaries work together?*

## Methodology

We propose design analysis (DA) as a useful investigative approach to biological systems. Current biological research is reverse engineering, which methodically disassembles systems. DA, however, begins with researchers forward engineering systems by thinking through how they would select and organize major elements and assembly sequences to achieve outcomes (e.g., vision) *before* reverse engineering commenced. Reference to similar human-made systems is valuable. This endeavor aids predicting findings before reverse engineering, assists correlating functions of discoveries, and helps rank their significance (i.e., from indispensable to merely aesthetic.)

A fundamental axiom of DA is that for human-designed entities, 100% of functional causality originates from within the object designed. To construct objects that successfully interact in their environments, designers must craft appropriate object-environment interfacing. Assuming a creation perspective, could God have done something similar in organisms? DA methodology describes all, but only tangible, system elements. It scrutinizes these elements in order to neither omit nor concoct anything that might confuse accurately discerning if the true cause for success/failure at solving environmental challenges is derived from the interplay of elements found in the organism. If it is found to be in fact an organism's traits that are operative, then DA rules help prevent biological explanations from attributing engineering causality to mystical expressions of environmental agency.

Would our understanding of immune systems be different with a fresh look by DA coupled with Francis's nonwarlike conception of our microbiota?

## DA Implies that Interface Systems Are a Fundamental Principle of Design

Understanding symbiosis based on design analysis starts by looking for an analogous human-designed relationship, whose mechanisms for operation are already understood, and see if there is a true correspondence between its constituent elements and those elements found within symbiotic biological relationships. One clear possibility, which contrasts sharply with warlike scenarios, is a mutually beneficial *business* relationship. Controlled communications enable transactions of information and resources. One party is a "requester," and the other is a "provider." Procedures may govern a ready reversal of "requester-provider" roles (which is likely the case in host-microbe relationships). Other analogous interface-regulated relationships also abound between distinct computing systems and even between humans and machines.

Biochemist Michael Behe popularized a biological principle known as "irreducible complexity." Irreducible complexity is even more fundamentally a basic principle of design. A*n irreducibly complex system is "a single system composed of several well-matched, interacting parts that contribute to the basic function, wherein the removal of any one of the parts causes the system to effectively cease functioning.*" (Behe, 1996, p. 39)

Our research below indicates that relationships between entities cannot arise naturalistically merely guided by natural laws. This means that distinct entities will interoperate in a useful manner only if organized to do so and cannot be forced to work together. Even if humans met a sentient "space alien," the two could not relate without some type of interface—notwithstanding how strongly each desired to do so. All relationships between biological entities is likely rooted in a basic design principle that something must *enable* them to work together.

We would propose another principle equally as fundamental as irreducible complexity: *In order for two autonomous, automated entities with distinct boundaries to work together, they must be connected by an interface with three distinctive elements: authentication mechanisms, standardized protocols, and a mutually accessible medium to both entities.*

Our method yields an explanation contrasting sharply with "coevolution." That oft-repeated coevolution claim, it should be remembered, is not an observation; it is solely a declaration. Coevolution is an assertion unhelpful for explaining the *origins* of elaborate, vital mechanisms that must link two distinct organisms. In reality, interface systems are the specific category of mechanism enabling these relationships. We will identify the interface-distinguishing elements within human-engineered interface systems.

## Interfaces Are Design Essentials for Two Interrelated Entities

"Interface" itself refers only to the relationship of two distinct entities. Therefore, an interface may range from a contact between two rock formations to elaborate programmed *systems* depicted as "icons" on computers that connect software programs to a human user. A placenta is a biological interface comprised of multiple systems from two distinct entities transiently connecting parent to offspring. Epithelial cells also display traits that, as will be shown, have the features of designed interface systems. Computer interface systems or placentas possess objectively identifiable interface-distinctive elements, mechanisms, interrelated steps, and functions.

Prominent interface designers, Kim Clark and Brian Petrini underscore the necessity of interfaces for cooperation, pointing out that "understanding interface characteristics is fundamental to understanding how systems interact with one another" and the uniqueness of their central elements, since "whilst some integration specifics [listed] come and go over time, the characteristics of integration between systems have remained largely the same" (Clark and Petrini, 2012).

## Extreme Information Demands: Interface Designers Must Understand Elements of *Both* Entities' Systems

Interface design is challenging. It is an information-intensive task to devise physical or logical mechanisms to harmonize independent, often dissimilar, entities. A mind is the only known origin of interface systems.

Clark and Petrini underscore the importance of an interface designer's *thorough knowledge* of *both* systems' operational details to be integrated "that there are really two sets of interface characteristics to be captured: … the capabilities of the provider, but you also need to know the requirements of the requester. As you compare the characteristics of requestor and provider, you can then establish the integration patterns that will be required to resolve the differences." And if that were not enough, they add, "To expose services effectively, you need to collate interface characteristics from the anticipated requesters for your system and also estimate the potential future requesters" (Clark and Petrini, 2011).

In fact, it is best to have a mind highly experienced with interface design since "nothing can replace the eye of an experienced integration specialist, who will be able to infer from the early characteristics captured that deeper investigation into some interfaces will be needed" and since "many projects fail to assess integration effectively. It is no doubt also clear that it would take significant experience to capture and assess such a large amount of information at one time" (Clark and Petrini, 2011).

## Distinctive Elements Characterize Interface Systems

Interfaces are regulatory-communication systems facilitating harmonious information/product exchanges (Clark and Petrini, 2012). Designers use in-depth operational knowledge of both unrelated entities to integrate their functions into three indispensable interface elements:

1. **Authentication** mechanisms differentiating self and non-self entities;
2. **Protocols** standardizing rules/processes governing exchanges; functioning through a
3. **Medium** of conditions mutually accessible to both entities.

These three well-matched elements constitute the minimal interacting parts needed to attain the basic function of an interface. *Removal of any one of the parts causes an interface system to effectively cease functioning*.

The following condenses Clark and Petrini's extensive discussion and integrates their material into a design analysis framework.

**Authentication**. To design an interface between two entities, the first task is to establish a mechanism called "authentication" to recognize "self" from "non-self." When you log into Amazon Corporation's website, you, along with your personal computer, will undergo authentication which is composed of several substeps. You will be *authenticated* as a non-Amazon entity while the interface system *verifies* your identity. Likely you will be *authorized* to begin transactions with Amazon. Some people's system will fail authorization and the encounter is ended. If you desire to purchase, additional authentication happens as you will be required to *disclose* specified information to Amazon, which the company's interface system will *validate*. Software on your computer may require Amazon to do similar actions.

Authentication is a special category of protocol. It accomplishes such a singularly important task that it is identified as a separate characteristic of interfaces. Rules and physical elements are both used to establish the identity and authenticity of other entities. Authentication protocols and internal programming may need to be sophisticated since a non-self entity could, for nefarious reasons, try to look like "self" or possibly the "non-self" of a completely different entity. Thus, interface designers usually devise authentication control logic for how the identity of an entity is to be authenticated. Then after an entity is accurately identified, other elaborate mechanisms will establish appropriate authorization for access.

Authorization encompasses rules governing more than recognition. It includes the concept of "validating" non-self. Since interfaces control the exchange of information and materials within "requestor" and "provider" relationships, providers expose their time and resources to requestors. Validation is critical for ensuring that only "authorized" or prearranged systems are able to make requests (or exchange products if desired). Without proper validation, a malicious requestor could try to monopolize a provider's computational resources by making endless requests.

When associations with multiple non-self entities is anticipated, a provider may have established procedures to either have a common response to all non-self entities regardless of differences or be able to differentiate between types and formulate customized responses. Data exchanges during validation usually occur at the request-response step. The extent of *exposure* and *disclosure* of one entity to another may be strictly unilateral, tightly regulated, or fully bilateral. This means that either entity may have procedures *not* to reveal the presence of "self" to the other entity.

Our body relates to hundreds of different kinds of microbes simultaneously. Examples below will show how certain cells in our own interface system mandate disclosure, validate information, authenticate identities, and authorize exchanges with only certain microbes.

**Protocols**. These are uniform or "standardized" rules, processes, or mechanisms established by the interface designer that work between requestor and provider in order to *regulate* the relationship. They control how, when, why, where, with what transactions are made. They specify acceptable shared data volumes, formats, codes, and interpretation rules to control the message conversation. For data to be intelligible, both systems must understand the format (e.g., order and punctuation) of the data. Protocols may enable a system to utilize multiple data formats and message mediums to interface with different entities simultaneously.

Physical attachment often precedes control. If actual physical contact will be an element of control, protocols specify the physical conditions (i.e., for living things protocols specify the trait(s) that enables physical attachment), which facilitate regulation through physical contact. Therefore, it is common that a *uniting element* fits together material elements at the boundaries of both entities like the Apollo-Soyuz docking station. In cases where physical contact is the sole means of control wherein a uniting element is used, the uniting element *is* the common access medium as discussed below. By physically attaching to a non-self entity, control over it to produce the desired outcome(s) is facilitated.

Many fascinating mechanisms for physical control exist. However, non-physical control mechanisms can be even more spectacular—and are harder to design and understand. One obvious example of where "noncontact" control is a highly desired outcome are "collision avoidance" systems. These systems are actually interface systems operating between aircraft, trains, and increasingly on automobiles. They rapidly gather, and may even exchange, information to control responses between potentially antagonistic objects. In this case, designers understandably do *not* want direct physical contact.

Nonengineering communities may not know how this control is achieved. The control of self is *always* through its *own* innate systems. The result is self-adjustments upon detection of changed conditions (either internal or external). Therefore, control of a non-self entity is predominantly *not* by violating distinct boundaries and directly manipulating non-self systems.

One aspect of design analysis directs researchers to think through the parts and steps of a system that a human engineer would need to specify in order to obtain the desired outcome. This helps to show that engineers must know the basic function of each system *up front*. Some of the information always remains external to both entities. Some of it may be utilized to preprogram each entity's system. The result is that *one system* will execute its own self-adjustments per its own innate systems in response to traits or conditions detected from the *other system*.

This is analogous to one factory producing products, say electric motors and switches, and moving them out of their factory to a transfer dock, where a second factory picks them up, uses them in its own process to produce a product, say a drill press, then moves that to the transfer dock, where the first factory picks it up and uses in its processes. Each factory has the capability to detect when the other's products are at the transfer dock, identify them, and then convey them into their factory. When one factory's product is at the transfer dock, it is a stimulus for the other factory.

Thus, for entities to harmonize, the interface designer foresees the outcome desired for each entity that will result from the relationship. These outcomes are actually the *consequential* end product of its own internal processes, which start after it detects specific conditions (i.e., stimuli) by another non-self system. It takes an elaborate design for one entity to *present specific external conditions* to an environment, that when those conditions are detected by a second entity, it self-initiates production of a product that results as a *particular* and *necessary consequence* of its own systems that it will put back into the environment, and the product is useful to the first entity—and then vice-versa (see Figure 1).

To the casual observer, it looks like one entity is directly controlling the other, but they are not. Each entity is actually controlling itself. But this relationship is tricky to understand because the interface designer and the logic he

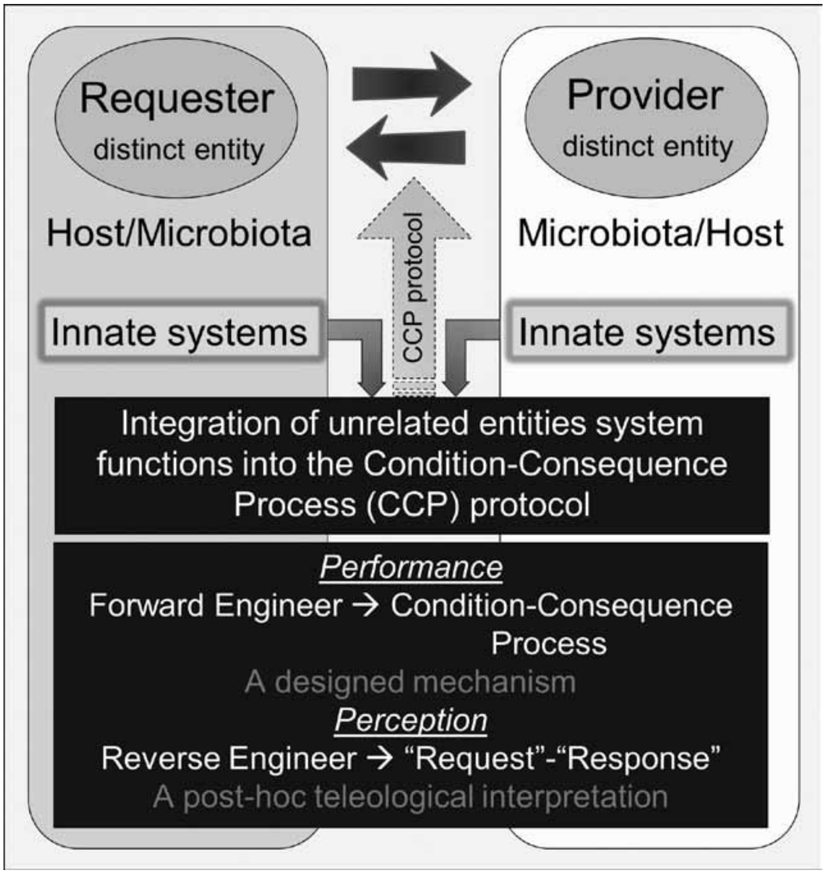

**Figure 1. Protocols are engineered interface mechanisms establishing reciprocal control in symbiotic relationships.**

Symbiosis is a relationship between autonomous entities characterized by mutually beneficial product/information transactions between requesters and providers. To develop protocols for symbiosis, designers must have in-depth knowledge of (1) unrelated entities innate system functions, and (2) system integration capability. The condition-consequence process is a principle control protocol developed when designers foresee eliciting a desired consequence caused by one entity's systems when presented with a specific environmental condition, particularly ones produced by the other entity's system. Reverse engineering correctly perceives the purpose but often mis-ascribes sufficient causality of outcome to the condition.

employed that enables the harmonization are not seen. The interface system's logic is "controlling" both through the outworking of actual physical elements within each individual entity. People are comfortable thinking about an immaterial thing like information controlling physical operations within the same entity. In this case, it is immaterial information controlling physical operations within *two* or more distinct, autonomous entities, but the logic information is not found within either.

What, then, is the design basis for a "stimulus?" A stimulus is an important element in the condition-consequence process. What makes any condition a stimulus for an entity? For human-made entities, the designer specifies a particular condition *to be* a stimulus—usually for specific purposes. The designer must also equip the entity with a detector sensitive to that condition and insensitive to other conditions. Then mechanisms to transmit data from detectors to logic centers, and so on, will be designed into the entity as well. Therefore, interface designers accomplish the stimulus-designation step by specifying in advance within one entity's systems very particular traits or products of the *other* entity to be "stimuli." Then designers program logic decisions controlling variable response actions. The same steps are followed for the other entity's systems. This prior programming serves as a common code of outcomes that facilitates very precise control (see Figure 2).

Designers must also formulate the interface's logic. When looking at any relationship (e.g., host-microbe, entity-environment, self and non-self) from the "detecting entity's" perspective, designated external conditions are either present (e.g., "on," "+," 1) or they are absent (e.g., "off," "-," "0"). When present and detected, then those conditions specified to be stimuli are "stimulating." In addition, the detecting entity's detectors and logic center may be designed to afford a "graded," not a strictly discreet, "on-off" response to varying quantities of the condition. The bottom line is that in precise engineering terms, conditions just exist; they are not active. Therefore, since the requester and provider each is controlling its own processes, specifying the exact external conditions to be stimuli for itself, supplying its own detectors, etc., then we may rightly call an external condition a "stimulus" or a "cue," but not accurately call it an "inducer" or a "trigger."

To the reverse engineer, the condition-consequence process between entities looks like an interchange of a "request" and a "response," which, if the interface designer did a thorough job, in a way it should. The interface de-

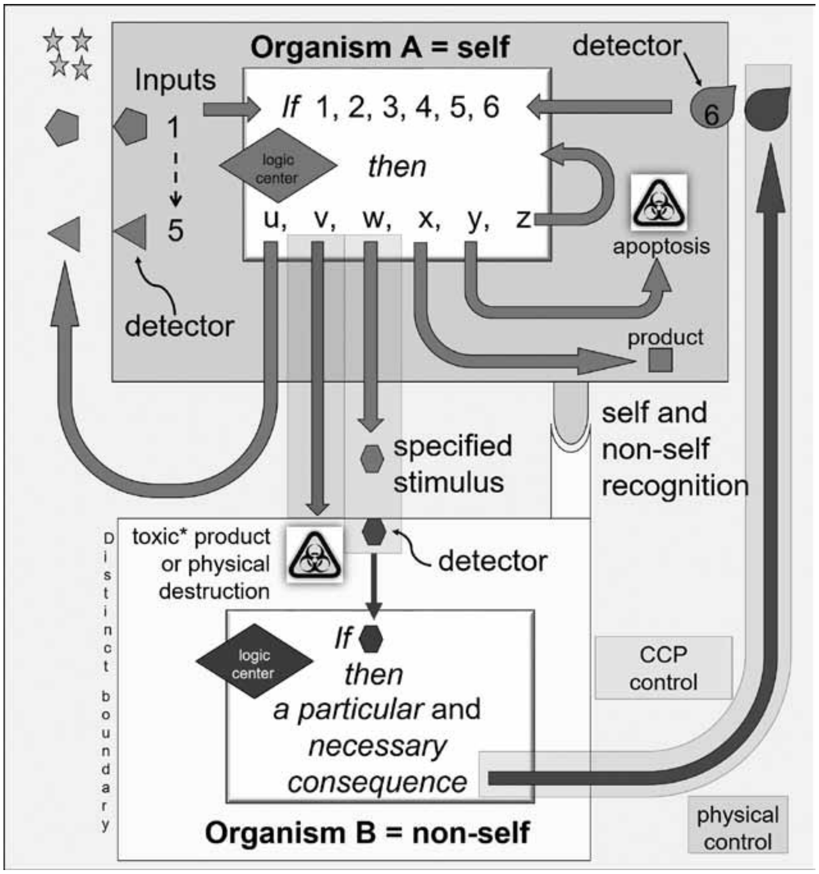

**Figure 2. How an interface utilizes the condition-consequence process.**

For autonomous and automated entities to harmonize, an elaborate interface design sets each up so that as organism A presents specific external conditions to organism B, B will elicit a particular and necessary consequence due to the outworking of its systems. Control of non-self is predominantly not by physically violating distinct boundaries and never bypasses non-self systems (Cabej, 2013). Each entity's systems specify in advance for themselves which trait of the other entity to be a stimulus. Therefore, it is crucial to know that this interface control is perceived only by outside observers since the true cause of control for both entities remains with innate self-adjustments via internal programming and detectors upon detection of either internal or external changed conditions.* Toxicity of products to organism B are determined by traits of B.

signer set the relationship up to look like one entity "requests" something from the other, which "responds" with a product (see Figure 1). However, what it appears like is not strictly congruent with reality. It is likely that in the majority of cases that happen at the subconscious level, each entity is operating totally "blind" to the larger picture. It does not understand that it is making a request or a response. It is itself simply functioning according to its own systems, but it is *also* functioning as a cog in a bigger system. The bigger system is really a type of protocol—just on a larger scale—for controlling outcomes through the presentation of conditions or data from one system that will produce an expected and necessary response from another system.

Since reverse-engineer biologists are "third-party" viewers, they *could* see the whole system operate exactly like the interface designer envisions it operating. But they must be trained to see things from a design perspective where cells, cellular components, and processes, for instance, are seen as elements in systems, and these elements are understood in their proper design role (i.e., detectors, logic centers, effectors, etc.).

**Common Medium.** Per Clark and Petrini, "You cannot even make two systems connect unless you can find a common transport" (Clark and Petrini, 2012), which means that a common medium is essential for any interface. This medium is a condition external to two or more entities that each must have at least one trait capable of being able to associate with. When one person speaks and another hears, they utilize the common medium of air, where one's vocal cords compress air, and the other's eardrums vibrate when energized by the compressed air.

In sum, with interfaces there are two major levels of intelligent design. The lower level is all of the information and materials to construct an entity and enable its autonomous operation. For man-made things, this information is stored on drawings and in computers. In living things, construction and operational information is contained *within* the organism. The higher level of design is information for how two or more entities are to work together. This information is not contained within the entities—it exists outside of them. Think of it like a radio transmitter that will transmit normally whether a radio is present or not, and a radio that will operate normally whether or not there is a signal from the transmitter. There are separate fabrication plans for the individual radio and individual transmitter. But the radio transmitter and the radio were designed to interface together as part of a larger communications system. The information for that system starts in the mind of the interface designer, and it is then developed into yet another set of overarching plans for that entire communications system. Thus, there are two levels of information.

The interface design argument is powerful. Evolutionists struggle to explain the origin of information for even an individual organism. But when it comes to highly interfaced relationships such as host-microbe, bee-flower, or male-female, evolutionary naturalists must claim that these relationships were never elements of any overarching plans, and then must appeal to everything coevolving together. When one reads "coevolution" in evolutionary literature, he or she should interpret that as evolution speak for two interfaced organisms. But, if "coevolution" amounts to no more than a declaration, then we must ask, where are the plans located to interface all the diverse organisms within ecosystems?

## Findings Illustrative of a Microbe Interface System in Humans

Given their intricate and vital relationships, it looks as though microbes were meant to work together with various hosts, including humans. And given that no known autonomous entities can even get sufficiently close (or even touching) one another that they start working together—but that some interface is still a necessity—then it would be tempting to simply declare that the immune system should be understood as an interface system. However, those observations would be meaningless if the characteristic of our immune system looked nothing like any interface systems that had ever been devised. We must determine if our immune system does, in fact, demonstrate essential characteristics identifiable as the three distinguishing elements of an interface.

### Authentication

If two factories are working very closely in support of each other, observers still recognize two distinct factories. We see, however, within the host and microbe incredibly tight integration of systems through bewilderingly complex mechanisms that masterfully resolve the problems arising from fundamental differences in form and function. Such thorough integration interventions, coupled to the observation that microbes live so intimately around, and sometime inside, the cells of the host, makes it powerfully tempting to assert that two autonomous entities have indeed become one. Do capabilities to achieve what engineers refer to as "seamless" operations forego the need to distinguish self and non-self—or is there still a host-microbe "seam"?

As pointed out by Kim, "Self versus non-self discrimination is a central theme in biology from plants to vertebrates, and is particularly relevant for lymphocytes that express receptors capable of recognizing self tissues and foreign invaders" (Kim et al., 2005, p. 709). But microorganisms must also make self versus non-self distinctions as evidenced by "clustered, regularly interspaced, short palindromic repeat (CRISPR) loci [to] protect bacteria and archaea from invasion by phage and plasmid DNA through a genetic interference pathway," which "evolve rapidly, acquiring new spacer sequences to adapt to highly dynamic viral populations" (Marraffini and Sontheimer, 2010, p. 568).

Authentication of self is an interface-distinguishing characteristic. One wide-ranging authentication mechanism in microbe interface systems is to employ the major histocompatibility complex I (MHCI) surface molecule possessing a unique "self" pattern. They are found on all nucleated cells in the body. To interface, both systems must recognize these patterns and, just like human-designed interfaces, become a common code (Janeway et al., 2001).

The toll-like receptors (TLRs) subgroup of sensors exemplify entity-to-entity bridging characteristics. TLRs consist of an extracellular ligand-binding domain, a transmembrane domain, and a cytosolic signaling domain. There are six major families of vertebrate TLRs that are distinct from that of invertebrates. The critical need for "recognition of and response to pathogen-associated molecular patterns has maintained a largely unchanging TLR recognition in all vertebrates" (Roach et al., 2005, p. 9577).

In many organisms, membrane-bound and cytosolic detectors called "pattern recognition receptors" recognize molecular arrangements on microbes. These sensors function very similarly to TLRs. Detectors fit and bind multiple microbial products (pathogen-associated molecular patterns) including lipopolysaccharides, lipopetides, flagellin, and DNA or RNA motifs. They are found in plants, yeast, invertebrates, and vertebrates (Boller and Felix, 2009). Lightner emphasizes this authentication features even in plants, stating that "ironically, in plants, the same group of compounds that is used to identify symbiotic microbes so healthy relationships can be established is also used to identify pathogens so the plant can defend itself. These compounds, lectins, are proteins that are able to bind to carbohydrates. The portion of the molecule involved in binding is highly variable, much like immunoglobins in our immune system" (Lightner, 2010).

Interfaces elements utilize downstream systems to convey data from external boundaries inward to control centers. Microbial interface systems employ ligand-gated, G-protein coupled, and a plethora of molecules to transfer data from cell-surface detectors inward. Authentication coupled with this other information in the pathway enables the human side of the interface to influence the composition of the gut microbiota that enables "mucosal immune responses to indigenous flora [which] require precise control and an immunosensory capacity for distinguishing commensals from pathogens" (Shanahan, 2002, p. 915).

## Protocols

Is there evidence that microbes and their host, specifically the host's epithelial cells that contact microbes, actually demonstrate a type of reciprocal control indicative of underlying protocols? Recent research has identified "the maintenance of physiological equilibrium at the mucosal interface, on which both host and gut microbiota exert reciprocal control" (Martin et al., 2009, p. 2090). Reciprocity, especially in symbiotic relationships, is highly indicative of the outworking of underlying protocols. Findings of *reciprocal* control means that "this raises the possibility that the mammalian immune system, which seems to be designed to control microorganisms, is in fact controlled by microorganisms" (Round and Mazmanian, 2009, p. 313).

A classic example of direct physical control is the complement cascade system. This multistep, complicated system consists of circulating pro-proteins that can be activated directly by certain membrane markers on bacteria or by the binding of antibody to a bacterium. After activation, the end result of either path is the assembly of the membrane-attack complex. This complex generates a pore in a bacterium's lipid bilayer membrane, which leads to its destruction (Janeway et al., 2001).

In some cases, analogous to how the uniting element fits together the boundaries of both entities (e.g., the Apollo-Soyuz docking station), protein structures in humans may physically match external characteristics of different microbes that literally enable a cell or molecule to dock with them. Specificity ranges from low to high fidelity. For instance, α-defensins can attach to a large range of microbes, while some microbial elements can be bound only by specific antigen-binding regions of immunoglobulins (Dietrich et al., 2008). Physical attachment to a non-self entity facilitates control of it by stimulating consequence-eliciting outcomes.

A couple of fascinating examples illustrate what looks like one entity directly controlling the other but is actually the interface system "controlling" both as a whole. They illustrate the condition-consequence process, where one entity presents specific external conditions to the other one that will elicit a particular and necessary consequence in another system.

Hosts "shape" the composition of the microbiota by several mechanisms. For example, microRNAs (miRNAs) were found to be normal constituents within feces of mice and humans, produced by gut epithelial and other specialized cells. The research on mice showed that these epithelial produced murine miRNAs are one link in *interspecies* gene regulation to enable host control of gut microbiota. Host-produced miRNAs are transported out of epithelial cells into the gut lumen. A yet unidentified transporter in the cell wall of bacterial species such as *F. nucleatum* and *E. coli*, import the murine miRNAs, where they are processed by intrabacterial cellular machinery. The result is a specific regulation of bacterial gene transcripts that affect bacterial growth. Mice genetically modified to not produce miRNAs were found to have uncontrolled growth and composition of microbiota and inflammation of the intestinal lining. However, fecal transplants from normal mice to miRNA-deficient mice restored control over the microbiota (Liu et al., 2016).

After someone eats a meal, what causes satiety, or that feeling of being full? Current explanations of appetite control reference mechanisms of gut-derived exocrine satiety hormonal signals to anorexigenic and orexigenic pathways in the hypothalamus (Berthoud, 2011). The satietogenic hormones, glucagon-like peptide-1 (GLP-1) and peptide YY (PYY), are produced and released by enteroendocrine cells in the gut. However, new findings demonstrate that gut microbiota also play an important role via the condition-consequence process. Within 20 minutes of eating, gut bacterial growth, particularly *E. coli*, increases exponentially, and they exhibit a remarkable change in proteome. *E. coli* proteins are released into the gut lumen. One protein, caseinolytic protease (Clp) B, is an antigen-mimetic of a satiety hormone produced within the host. Clp-B is transported by human gut cells into circulation. In addition, when other *E. coli* proteins are detected by the host enteroendocrine cells, they release into circulation their satietogenic hormones, which travel to the hypothalamus (Breton et al., 2016). It is currently unclear, but *E. coli*-derived proteins may be essential for enteroendocrine cells to release their hormones.

In like manner, body cells and microbes exchange many products that are controlled by diverse nonattachment interface mechanisms. Additional protocols seem to regulate requester-provider processes to control microbiota composition and microbiota regulation of lymphoid structure development and epithelial function via MyD88-dependent RegIIIγ signaling pathways (Hooper, 2012). Intestinal paneth cell defensins regulate the composition of small intestinal bacterial microbiota by shifting dominant bacterial species without changing total bacterial numbers, which shows "a novel role … in intestinal homeostasis, by regulation of the small intestinal microbiome" (Salzman, 2010, p. 401).

For instance, certain cells in your body's interface system may authenticate three different types of bacteria in your gut; say, *Escherichia*, *Bifidobacterium*, and *Staphylococcus*. Your interface cells may physically attach to these bacteria (or other proteins may directly attach to them as noted above) for the purpose of regulating their activity and population sizes in the gut. Some examples of "desired" outcomes of this host-microbe relationship include self-setting specific conditions so that the bacterium produces a product, initiating a bacterium's preprogrammed self-destruction, or by directly destroying the bacterium.

Microbiome research provides fresh insights into the effectiveness of these interface controls. Early research on the gut showed that certain gut microbes are regulated by intestinal homeobox genes. Reciprocally, commensal-gut microbiota could elicit host gut responses, such that, "taken together, these results reveal that *Cad* [a homeobox gene] acts as a critical host factor that maintains the immune homeostasis responsible for preservation of the normal commensal community structure" (Ryu et al., 2008, p. 781).

## Common Medium

Biochemical physical conditions are mutually accessible to host and microbe. Biochemical conditions are the common medium that facilitates essentially all transactions between host and microbe via the interface characteristic. One example of how these biochemical reactions work is defensin-bacterial interactions. Defensins work by interacting with the *charge* of the bacterial cell envelope through covalent modification of anionic molecules or altering membrane fluidity (Peschel, 2002).

## Design Analysis Enables Predictions

We know that some human-designed interfaces operate by a logic to place requests and responses in a queue. Is there any type of queue or queueing effect at the microbe-host interface? We are unaware of any type of effect yet documented in literature on immune systems. Given the numbers and different types of microbes in the gut, we can only imagine the number of transactions processed by each host MIS cell. Without some kind of processing control, they could produce chaos. We suspect that future research will find mechanisms in our MIS to logically arrange transactions into a queue (or parallel queues) for subsequent processing. These could be identified as multiple systems management procedures for working with more than one discreet process at a time. They will display protocols to map and regulate sharing real-time information from associations with one or more non-self/requestor system.

Since *timing* is always important to either cell cycles or circadian rhythms, for instance, we anticipate that protocols for synchronization will be found.

Tolerance to different dynamic conditions will display design strategies for self-adjusting to changed, exceptional, or unexpected conditions. This means that there will also need to be rules for error handling and management rules for how and by which system exceptions are handled. By basic principles of design for dynamic systems, the MIS must demonstrate *resilience*, meaning it must be robust enough to maintain its central function but also plastic to flex with unforeseen conditions—some of which may not have shown up on earth yet.

## Changing Views: Name Changes Often Reflect a Better Understanding

Is a proposal to adopt a new perception of host-microbe interface systems for regulatory purposes and drop perceptions of "immune" systems for defensive purposes a radical idea or simply an effort to keep up with the latest data? Host-microbe mutualism has been understood for decades, but not everyone tracks with the latest data or concepts.

For instance, consider conflicting comments from three texts all published in 2012. "Every second of every day, an army of hostile bacteria, viruses and fungi swarms on our skin and invades our inner passageways—yet we stay amazingly healthy most of the time. The body seems to have developed a single-minded approach toward such foes—if you're not with us, then you're against us!" (Marieb, 2012, p. 403). But, as Gordon (2012, p. 1251) noted above, this harkens childhood memories of how "we saw our relationship with microbes portrayed in warlike, rather than in mutually beneficial, terms." Others have recently compared the vital, life-sustaining commensal benefits of microorganisms to our health to being "married" to them since "they have a fundamental role in synthesizing vitamins and in helping to breakdown nondigestible products that provide energy to the human body" (Ray, 2012, p. 555).

Careful microbiota researchers like McFall-Ngai have progressed to a current, if not more correct, view of seeing at least adaptive "immunity" in a regulatory function. Though she eschews design in favor of evolution, she says, "I propose a different explanation: that adaptive immunity has evolved in part to *recognize and manage* complex communities of beneficial microbes living on or in vertebrates" (McFall-Ngai, 2012, p. 153, emphasis added). Molecules on the cell wall of bacteria are collectively called "pathogen-associated molecular patterns" or PAMPs. But, a recent article in *Nature* notes a call to replace the misleading word "pathogen" with a more neutral "microbe" or MAMPs (Yong, 2015).

One Belgian researcher has also recommended a complete redefinition the immune system based on a cooperative and non-warlike understanding in his 2013 paper, *Redefining the Immune System as a Social Interface for Cooperative Processes* (Muraille, 2013). Though the "social interface" he suggests is very different from the functional interface we propose, central to his concept was the basic purpose of regulating relationships. Creationist microbiologist Joseph

Francis was a decade ahead of the evolutionary biologists.

## Implications for the Creationist Model

The power of a theory rests in its ability to offer a plausible causal mechanism to an observation that needs explaining. Its power is enhanced if it can also account for multiple phenomena related to the observation.

In this case, the observation raises this question: How do two automated, autonomous entities with distinct boundaries work together? This question is answered with a principle of design indispensable to engineering practice: They must be connected by an interface with three distinctive elements: authentication mechanisms, standardized protocols, and a mutually accessible medium to both entities. The following implications are based on this principle being true.

First, looking only at the microbe interface system itself, we see several important implications.

- An engineered-based explanation offers a better way for creationists to answer the question, "If God originally created the world without death and disease, where did our bodies get their disease-fighting capabilities?" The reality of a MIS makes creationist explanations totally different than widely held ones. Pre-Fall disease fighting systems are somewhat of an enigma to explain when seen in death-survival naturalistic paradigms, but there is no enigma when this is not a defensive system but is as interface that is an absolutely necessary design requirement to harmonize autonomous entities. The MIS steers clear of postulating that since God foreknew the Fall, He hid in Adam a latent immune system whose activation was mediated by post-Fall conditions. The MIS is preferable because explanations that work only by invoking God's omnipotence/omniscience do not truly explain anything since, obviously, they can explain everything. In addition, no known scientific tests unambiguously detect mediating interventions by either God or environmental conditions.
- Since humans have likely associated with microbes since creation, which means that an MIS was a design certainty, then design-oriented researchers should have been looking to find—and describe—the interface system for decades. Given the wisdom of God, the fact that an MIS and microbiomes function together in what human engineers would call a "seamless operation" is not surprising. Interface design shows multiple levels of system knowledge and irreducible complexity, which makes the standard evolutionary explanation, "the gut epithelia of virtually all organisms have evolved to form a mutually beneficial strategic alliance with microorganisms" (Ryu et al., 2008, p. 782), implausible.
- The MIS has likely *not* changed much from its original—and continuing—main *regulatory* purpose.
- Cell-destructive capacity of the interface system for regulatory purposes (and some recycling purposes, e.g., antiquated red blood cell destruction in the spleen) was always an MIS design feature. Post-Fall destruction for subsequent "defensive" purposes is still clearly a manifestation of regulation. What has changed post-Fall are (a) the potential for breakdown and loss of regulation; (b) potential to be overwhelmed; (c) displacement of microbes into "abnormal" environments; (d) destruction of mutant and cancer cells; and (e) very dire consequences of the loss of control.
- In this view, parasitism is the *violation* of distinct boundaries of one entity upon another. This is in contrast to mutualism which does not violate boundaries between entities.
- The MIS is dynamic and augments a creature's ability to rapidly "fit and fill" new niches without necessarily involving genetic changes in themselves. Research on humans "demonstrate[s] that the gut microbiome can rapidly respond to altered diet, potentially facilitating the diversity of human dietary lifestyles." Microbiota composition may rapidly adjust since "work in inbred mice shows that shifting dietary macronutrients can broadly and consistently alter the gut microbiome within a single day" (David et al., 2014, p. 559). The remarkable result is that "symbiotic gut microbes ... perform multiple digestive and metabolic functions for the host, and this has resulted in the ability of organisms to engage in enhanced adaptive radiation to exploit new dietary resources" (Martin et al., 2009, p. 2090). This apparently seamless operation between two independent systems is wonderfully illustrated in a study showing how desert wood rats could rapidly fill a new niche by consuming normally toxic creosote plants and access nutrients. The change was a different composition of gut microflora that could detoxify creosote (Kohl, 2014).

Second, there are several important implications for utilizing design analysis in biological research.

- Design analysis identifies innate condition-consequence mechanisms as the true engineering cause for creatures driving themselves through space-time. An innate interface system enables a certain flexibility in an organism to perform well in a world that isn't precisely modeled ahead of time. Organisms that use their preexisting innate systems to either successfully solve environmental challenges or not oppose the accepted notion that as organisms they *are being* driven or "pressured" by environmental challenges. Evolutionists claim that organisms are slowly being crafted by nature over time—which is purported to be the true cause of their apparent design.

- Design analysis identifies multiple, definitely bounded individual kinds of self-regulated entities—a host and a microbe—with no loss of distinctiveness or identity. Some researchers may believe that hosts and microbes engage in seamless "interactions," but DA shows that there really is a seam. To not recognize the seam may advance misleading conclusions about autonomy-blurring amalgamations such as human-microbe mosaics, supra-organisms, or trans-human collectives. Whole understanding of distinct "kinds" of organisms, including humanity, may become fuzzy. For instance, consider this perception: "However, if the view of what constitutes a human is extended … if humans are thought of as a composite of microbial and human cells, the human genetic landscape as an aggregate of the genes in the human genome and the microbiome, and human metabolic features as a blend of human and microbial traits, then the picture that emerges is one of a human 'supraorganism'" (Turnbaugh et al.,

## Box 2: Evolutionary Assertions of Loss of Autonomy

The Bible is clear that man was created in God's image. Conversely, secularists maintain that further research of the microbiome suggests humans and microbes may not be autonomous entities. They suggest humans and microbes are now a "superorganism," or a "splendid amalgamation" of trillions of prokaryotic and eukaryotic cells.

> I'm fascinated by the fact that we are a multispecies self. That sounds kind of highfalutin, but what it means is that we as humans need to have a larger view of ourselves as a life-form. We have our human self. We also have a microbial self. (Garrett, 2014, p. 7)
>
> Integrating microbes into our concept of 'self' contextualizes our views of human development, our sense of individuality, and our connections to family and environment in new and different ways.… We are prompted to consider that there is another dimension to our human evolution and human condition.… Even though we now know that we are a splendid amalgamation of microbial and human cellular and genetic parts—more microbial than human in many ways. (Gordon, 2012, p. 1251)
>
> We may think of ourselves as just human, but we're really a mass of microorganisms housed in a human shell. (Brody, 2014)
>
> Outnumbered (on a cellular level alone) by our microbial 'mates' by 10 to 1, a question arises: are we more microbe than man? Increasingly, it seems that the gut microbiota can be considered as a human microbial 'organ'. From an ecological point of view, it could be argued that humans are a superorganism, a communal collective of human and microbial cells working as one. (Brody, 2014)
>
> What is self is a fundamental question in biology.… Based on the unique ability to discriminate between cooperative and cheater partners of an SI [social interface], the self becomes the sum of cooperative and interdependent partners. (Muraille, 2013)

As much as secular biologists would want to see us as just a blend of human and microorganisms, the reality is that creatures reproduce after their kinds. When human egg and sperm fuse are fertilization, there is *no* genetic material from the microbiome transmitted, only human.

Another secular assertion is viewing the microbiome as another human "organ" functioning like an "ancillary," "supplementary," or even a "virtual" organ.

> Collectively, the resident flora represent a virtual organ with a metabolic activity in excess of the liver and a microbiome in excess of the human genome. An improved understanding of this hidden organ holds secrets relevant to several infectious, inflammatory and neoplastic disease mechanisms. (Shanahan, 2002, p. 915)
>
> The microbiota can be viewed as a metabolic "organ" exquisitely tuned to our physiology that performs functions that we have not had to evolve on our own. (Backhed et al., 2004, p. 15718)
>
> The consortium of symbiotic gut microorganisms (the microbiome) can be viewed as a metabolically adaptable, rapidly renewable and metabolically flexible virtual "organ." (Martin et al., 2009, p. 2090)

2009, p. 804). Multiple scientific papers affirm the amalgamation of humans and microbiome into some type of mosaic (see Box 2). When researchers conclude that "our data also suggest that major mammalian metabolic processes are under gut symbiont homeostatic control" (Martin et al., 2009, p. 2102), they express a concept arising from the notion of coevolution, where one entity is molded by external pressures to service the other entity. Design analysis objectively identifies multiple interface systems and highlights independent condition-consequence mechanisms so clearly that each *never could* co-regulate or engage in symbiotic homeostatic control.

- DA eliminates mystical steps in biological descriptions and identifies true engineering causality in condition-consequence processes. DA identifies extensive integration of distinct innate systems, which makes the explanation for the vital, incredibly tight fit as being coevolution far less plausible.

## Summary

Adam was likely created with a fully functional microbe interface system enabling him to relate to communities of microbes on his body. The necessary collection of gut microbes was placed in him by God at his creation. Even those who embrace the origin of a defensive system through a struggle for survival occasionally marvel at the overwhelming host-microbe peaceful coexistence: "Although the immune system is classically thought to have evolved to protect from infection by microbial pathogens, animals peacefully coexist with a vast and complex microbiota, which extensively interacts with the immune system" (Round and Mazmanian, 2009, p. 313). Noting the same widespread incongruity, could the application of design analysis offer a more precise explanation for the function of the "immune" system as that of a necessary interface system if any mutually beneficial microbe-host relationship could exist?

The interface designer's *thorough knowledge* of *all* the systems to be integrated is essential. Creationists and ID advocates should begin to accentuate this point when making the case for ID. This greatly compounds the "what-is-the-source-of-information" question. It is difficult enough to come up with a plausible evolutionary explanation for the information carried by DNA. Now, a natural explanation would have to be offered to explain the source of information controlling two or more entities—all linked together in massive ecological webs—and the complete set of logic involved remains to a major part to be elucidated (unlike, for example, the information for genetic logic switches *is* in DNA). Evolutionists simply appeal to explanations that it evolved and coevolved.

So, why should microbes relate to inanimate or animate entities at all? Well, one function may be that microbes themselves act as a collective interface to sources of raw materials. Any individual microbe is an impressive biochemical cycler and the prodigious outcome of their cumulative action is vital for life's functions on earth. Though nearly ubiquitous within habitable zones, they are, appropriately, found "in the highest concentration at interfaces between major parts of the biosphere, that is, the interface between the lithosphere and hydrosphere, or the hydrosphere and atmosphere (Curtis, Sloan, and Scannell 2002)" (Francis and Purdom, 2009, p. 86). Another reason is that they confer benefits that last a lifetime and cross multiple generations. But most importantly, since building an interface demonstrates the ability to know both functions and the capabilities and needs of both, they display the incredible design genius of our Creator.

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