The Inherence Heuristic: Generating Everyday Explanations

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Abstract

The ability to explain enables humans to understand their world and informs much of their behavior. And yet, little is known about the psychological processes by which explanations are generated. Here, I describe a recent proposal on this topic. According to this proposal, people come up with explanations much as they come up with solutions to other complex problems—*heuristically*. Extensive research on human reasoning has suggested that people answer difficult questions (e.g., how satisfied are you with your life?) by retrieving simple information that comes to mind easily (e.g., I am in a good mood right now) and then using this information to construct an approximate answer. Prompts for an explanation (e.g., why do we eat eggs for breakfast?) are hypothesized to trigger a similar process. This process oversamples highly accessible facts about the entities in the observation to be explained. Owing to the organization of memory, these accessible facts are more often about the inherent features of the relevant entities (e.g., eggs have a lot of protein) than about their history, their relations to other entities, and so on. This skew toward inherence then propagates through to the final product of this heuristic process, which is typically an inherence-based explanatory intuition (hence the name *inherence heuristic*). The inherence heuristic proposal sheds light on the mechanistic underpinnings of explanation and has implications for our understanding of other cognitive phenomena of societal importance (such as the tendency to explain membership in social groups in terms of deep biological "essences").

INTRODUCTION

A considerable chunk of our mental lives is spent trying to make sense of the world (e.g., Gopnik, 1998; Lombrozo, 2012). Even young children are brimming with *why* questions about everything from the smallest event (e.g., why did the toy break?) to all-encompassing regularities (e.g., why are some people rich and others poor?). This should come as no surprise, as our actions are informed by explanations in virtually all aspects of life: when we interact with others (e.g., why is this person behaving oddly?), when we do our jobs (e.g., why did the undergraduates do poorly on the quiz?), when we plan

our finances (e.g., why are interest rates low?), when we assign blame (e.g., why did the cookies burn?), and so on. As spontaneous explanations form the basis for much of what we do, investigating the process by which people generate these judgments is an important task for social and behavioral scientists in the coming years.

A noteworthy piece of the puzzle here is the seeming ease with which explanations are formulated: It is rare that people are just baffled by a prompt to explain; rather, explanations come to mind quite readily, even in cases where they have to be constructed from scratch (rather than simply retrieved from memory). And yet, many of the *why* questions we confront on a daily basis are about phenomena and events that are in reality enormously complicated—not the sorts of things that can really be figured out on the fly. For example, the amount of information needed to generate an accurate explanation for the current interest rates or for social stratification is staggering. How do people manage to generate *any* sort of answer to these questions in the moment? The account I describe here proposes that, just as in other areas of human judgment, our cognitive systems generally rely on simple, easy-to-access information and proceed to build an explanation from this information in a heuristic fashion, going with the first plausible explanatory intuition that comes to mind and seldom considering the full complexities involved in finding answers that are normatively correct.

Before elaborating this account, I provide a few remarks to situate it in the broader context of empirical research on explanation. Despite the central place of this process in human experience, research on explanation was somewhat slow to take off in psychology (for reviews, see Keil, 2006; Lombrozo, 2012), especially by contrast with related fields such as philosophy. Because explanation is a relatively new focus for psychologists, researchers have naturally gravitated toward the rich philosophical literature for theoretical frameworks with which to approach the empirical study of this topic (e.g., Hempel & Oppenheim, 1948; Kitcher, 1981; Salmon, 1998). Being able to capitalize on the existing philosophical work has led to much elegant research in this fledgling area (e.g., Lombrozo & Carey, 2006; Prasada & Dillingham, 2006). On the other hand, the close links to philosophy have also led to a stronger focus on explanation as a *product* than on explanation as a *process* (a distinction articulated by Lombrozo, 2012). With few exceptions, philosophical arguments treat explanations as products—as stand-alone objects of study. That is, philosophers generally take it as a given that there exists some explanation or other and proceed to investigate what properties this explanation must have in order to do its explanatory work (e.g., it must include mention of a cause; it must identify a mechanism; it must include a general law). Much less consideration is given to *how* a person might come about an explanation. Correspondingly, empirical research rooted in these arguments often

seeks to identify which properties laypeople see as important for explanations to possess. Clearly, establishing a taxonomy of such properties is a key goal for a psychology of explanation. At the same time, it is also important to investigate how explanations embodying these properties are *generated*. In psychology, as well as many other sciences, satisfactory accounts of a phenomenon typically involve descriptions of the mechanism by which the phenomenon comes about: How do people actually get from (self-)asking why something is the case to formulating an explanation in response to this question? Spelling out this process is the intended contribution of the recent proposal of an *inherence heuristic* (Cimpian & Salomon, 2014a, 2014b).[1] In what follows, I describe this proposal and then sketch some of the promising lines of work that I envision to emerge from it.

THE INHERENCE HEURISTIC

The present proposal starts from the premise that people use some of the same cognitive machinery to generate explanations as they do to solve problems, make decisions, and so on. In other words, explanations are assumed to be an instance of everyday reasoning. From this perspective, an account of the process by which explanations are generated would be well served by incorporating what is known about how people think and reason more generally.

Heuristic Reasoning

Although a complete account of human reasoning is not forthcoming, one conclusion that has emerged consistently from research on this topic is that humans tend to reason *heuristically* (for reviews, see Kahneman, 2011; Shah & Oppenheimer, 2008). Whether they have to estimate the likelihood of an outcome or event, determine whether an argument is persuasive, or decide which of several options is best, people seldom do a comprehensive search for all facts pertinent to such complex judgments. Rather, they often take the first piece of information that pops into mind (usually, information that is salient and accessible in the moment) and use it to construct a quick, plausible answer. This is a *heuristic* answer—an approximate, easy solution whose overlap with the *correct* answer is rather uncertain. If I am asked to evaluate whether there are more doctors or lawyers in the United States, for example, and I answer this question based on whether I personally know more doctors or more lawyers (which is the sort of easily accessible information that underlies heuristic solutions), the accuracy of this on-the-fly answer is far from guaranteed. That is, there is no way of telling whether the small samples of doctors and lawyers I know personally are at all representative of the

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1. For other promising leads, see Rozenblit and Keil (2002) and Chin-Parker and Bradner (2010).

larger groups whose relative size I was asked to estimate: My experiences may be representative, but they may also be skewed in any number of ways. And yet, this is how a lot of everyday reasoning proceeds.
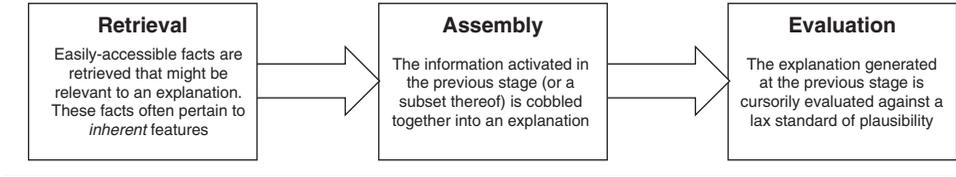
The tendency to adopt heuristic answers of this sort is due to the very architecture of the reasoning system. Most heuristic answers are the spontaneous outputs of shallow, implicit reasoning processes (sometimes collectively termed *System 1*; Stanovich & West, 2000) that are triggered as soon as a problem or question is posed to the reasoner. These heuristic outputs are then submitted for evaluation to analytic (System 2) reasoning processes, which can endorse the heuristic intuitions if they are deemed adequate or otherwise intervene and correct these intuitions. However, intervention by analytic, working-memory-dependent processes is relatively rare because, as Evans (2006) put it, there is "a fundamental bias in the analytic system to work with the representation it has unless there is good reason to give it up" (p. 379). Thus, the tendency to adopt quick-and-easy heuristic intuitions arises out of the convergence of two basic facts about cognitive structure: (i) the presence of a set of implicit heuristic processes that are continuously, prolifically supplying intuitions to higher cognition and (ii) the lax scrutiny provided by analytic processes over these heuristic inputs, which allows them to be endorsed under most circumstances.

Note, however, that the tendency to reason heuristically is just that—a *tendency*. It is by no means inescapable. Although the analytic system generally goes along with the heuristic intuitions supplied to it, it is obviously capable of taking the reins. Whether it does so depends on a variety of situational and individual-difference factors: for example, how motivated the reasoner is to be accurate (e.g., Chen & Chaiken, 1999), the availability of the cognitive resources needed for the operation of working-memory-intensive analytic processes (e.g., Epley & Gilovich, 2006), and the reasoner's level of preference for reflective, effortful thinking (e.g., Stanovich & West, 2000).

Heuristic Explanations

I now return to the problem I started with: How do people generate on-the-fly explanations? A potential answer to this question was recently suggested by the *inherence heuristic* account (Cimpian & Salomon, 2014a, 2014b; see Figure 1 for a visual summary).

According to this account, everyday explanations—just like so many other instances of reasoning under uncertainty—are generated via a heuristic process. When people wonder why something is the way it is, they are likely to start their search for an answer with the information that is most salient and accessible to them at that point in time. What information might this be? A first impulse here might be to think that what is most accessible

Retrieval	Assembly	Evaluation
Easily-accessible facts are retrieved that might be relevant to an explanation. These facts often pertain to *inherent* features	The information activated in the previous stage (or a subset thereof) is cobbled together into an explanation	The explanation generated at the previous stage is cursorily evaluated against a lax standard of plausibility

Figure 1   Schematic diagram of the inherence heuristic.

in the moment will depend entirely on what is being explained, and thus that no meaningful generalizations can be made about the content of this most-accessible information. After all, it seems self-evident that different explananda (i.e., observations to be explained) are going to call to mind very different facts. And yet, a core proposition of the inherence heuristic account is that there exists at least one feature that is typically shared by the information activated for the purpose of generating an in-the-moment explanation, no matter what is being explained: Specifically, this information will tend to be about the *inherent* (constitutive, stable) features of the entities that make up the explanandum.

This claim, which gives the heuristic its name, is motivated by well-established facts about the process of activating knowledge in response to a stimulus and, more broadly, about the organization of memory itself. When a stimulus (such as a *why* question) is presented, the process of retrieving information from memory for the purpose of generating an appropriate response follows a predictable course (for an excellent review, see Higgins, 1996). Retrieval usually begins with information about the stimulus itself and about any other entities that are salient in one's mind as a result of exposure to the stimulus. When the stimulus is an explanation prompt, these salient entities will often be the constituents of the explanandum. For example, if I wonder why so many children's menus at restaurants have macaroni and cheese as an option, my search for an answer might begin with what I know about the main constituents of the fact I'm trying to explain: in particular, children and mac-and-cheese. The cognitive prominence of these entities at the moment when I am starting to think of possible reasons will be taken as a signal that these entities provide clues toward a response.

The heuristic process then goes on to retrieve information about these currently-salient entities—information with which to build a quick explanation. Two constraints are relevant to how this retrieval proceeds. First, as is the case with heuristic processes more generally, retrieval for the purpose of generating a heuristic explanation takes the path of least cognitive resistance. More specifically, retrieval proceeds down a gradient of accessibility, starting (and often ending) with the information highest in accessibility and thus easiest to activate. To clarify, not all information that is in principle *available*

in memory is equally *accessible*. When I think of mac-and-cheese, I can effort-lessly retrieve information about its creamy taste and its artery-clogging nutritional content; in contrast, it might take me several seconds to retrieve information about how much a box of Kraft mac-and-cheese costs at my grocery store. All of these facts are available, but only the former are also easily accessible.

A basic fact about human memory becomes relevant at this point. Memory is organized such that the information about an entity that is most highly accessible tends to be information about the *inherent features* of that entity—about the properties that describe its basic structure and constitution (e.g., Devine, 1989; Hussak & Cimpian, in preparation; McRae, Cree, Seidenberg, & McNorgan, 2005). The taste and nutritional content of mac-and-cheese are good examples of what I term inherent features. As a rule of thumb, inherent features are those features that a thing possesses by virtue of how that thing itself is, without involving entities external to it (Lewis, 1983); to put it another way, inherent features are those that, if changed, would produce a real change in the thing itself. Features such as these form the core of our semantic representations of entities in the world, which is why they are often the bits of information that come to mind most readily when memory is queried. As a result, a heuristic process that retrieves information down an accessibility gradient will often end up activating a pool of predominantly inherent facts about the entities that make up the explanandum.

So far, I have described one constraint on the heuristic retrieval process—namely, its preference for information that can be retrieved without much effort. This process may also be guided by a second con-straint: *relevance* (e.g., Evans, 2006; Sperber & Wilson, 1995). Even among a set of highly accessible facts, some will be more relevant than others to answering a certain *why* question. When I wonder why children's menus often have mac-and-cheese on them, the fact that children have two arms and two legs is not relevant, although it may be accessible. One reason is that explanation is often contrastive—we want to explain why X is the case *rather than Y* (e.g., Chin-Parker & Bradner, 2010; van Fraassen, 1980). In this particular case, I want to explain why children's *rather than adults'* menus so frequently include mac-and-cheese, and a feature that is shared by children and adults (such as having two arms and two legs) is unlikely to explain any differences between them. Thus, heuristic retrieval is guided by relevance considerations toward accessible facts that might eventually be useful for generating an explanation. One might wonder, however, if heuristic processes such as the one hypothesized here have sufficient computational power to determine relevance, which is a relatively com-plex, context-dependent property of a fact. The evidence in the reasoning

literature suggests that they do. Relevance computations are pervasive and automatic (e.g., Sperber & Wilson, 1995) and have featured prominently in previous accounts of heuristic reasoning (e.g., Evans, 2006). It is thus entirely plausible that the inherence heuristic avails itself of these fast, implicit computations of relevance.

One final remark concerning this relevance constraint on retrieval: Although I have described it so far as being independent of the first constraint (that retrieval proceeds from more to less accessible information), the two may actually share some underlying principles. Specifically, information that is highly accessible in memory may often be assumed to be relevant *simply by virtue of its accessibility* (Sperber & Wilson, 1995). Thus, because both the accessibility and the relevance constraints favor low effort, they may often guide retrieval toward the same facts in memory.

Once the heuristic has retrieved an assortment of highly accessible, relevant facts (most of which are likely to also be inherent), it will start to assemble them into the shape of an explanation (the second step in Figure 1).[2] Staying true to its heuristic nature, this assembly stage takes opportunistic advantage of any explanatory framework that can quickly help it make sense of the information activated from memory. For example, I might decide that mac-and-cheese is a staple of kids' menus because its taste is creamy and simple, which causes children to like it (an inherence-based explanation). In contrast, it may be unlikely for me to generate explanations based on more extrinsic, but typically less accessible, facts such as the ease of mass-producing, shipping, and storing the ingredients for mac-and-cheese in the context of the current American agro-industrial system (which might make mac-and-cheese particularly appealing to restaurants). More generally, the inherence heuristic proposal makes the following claim: Because the raw materials available to the assembly stage of the heuristic will typically be biased toward inherence, the output of this stage will likewise skew toward explanations that appeal to the inherent features of the entities in the explanandum (e.g., the taste of mac-and-cheese). In this way, the simple fact that the retrieval stage tends to oversample inherent facts (because of their accessibility) shapes the entire course of this heuristic, leading it to generate a preponderance of inherence-based explanations. (To be clear, however, the term *inherence heuristic* refers to the entire heuristic process depicted in Figure 1, no matter what its output is. Including *inherence* in the name of the heuristic is meant to signal that its *typical* output involves inherent features. However, the inherence heuristic [as a process] can just as easily output explanations that rely on extrinsic-historical facts. This would occur on the

2. I am not making strong claims about the temporal ordering of these stages. It is possible, and in fact likely, that retrieval continues in parallel with the heuristic's first attempts to construct an explanation out of the facts retrieved up to a certain point.

select occasions when these facts happen to be highly accessible in memory and are picked up by the heuristic's retrieval stage.)

The assembly stage is also where our account dovetails with much of the current work in the cognitive science of explanation. Specifically, the operation of this stage—where the structure of an explanation is imposed on the loose content supplied by the retrieval stage—will be influenced by whatever psychological constraints on the structure of explanations are identified in the literature (e.g., simplicity; Lombrozo, 2007). That is, our basic expectations about what an explanation should look like will undoubtedly influence how explanations are put together during this stage. In addition, these expectations may inform how the heuristic process evaluates the explanations it is generating, with explanations that embody more of the preferred explanatory properties arguably being judged more plausible.

Despite these constraints, the assembly stage is opportunistic—even promiscuous—in its pursuit of an explanation. The facts retrieved from memory are sometimes stitched together with the help of causal relations, but the heuristic takes advantage of other explanatory relations as well. I might judge, for example, that the taste of mac-and-cheese makes it particularly suitable for kids. The *suitable-for* relation is not causal but rather normative (or value-based), as are relations such as *ideal-for*, *optimal-for*, and so on. The heuristic relies on an extensive range of such explanatory relations. In effect, the only regulatory check on its operation is that the explanations it generates have to pass a plausibility threshold. However, as is true of heuristics more broadly, this threshold is set at a modest level. In addition, the analytic processes that supervise the inherence heuristic—and that could in principle intervene to revise its output—typically act as bystanders. As a result, the heuristic's inherence-dominated output is often the judgment people end up adopting (Cimpian & Salomon, 2014a, 2014b).

In summary, the inherence heuristic proposal draws from research on human reasoning and memory to develop an integrative new perspective on the process by which everyday explanations are generated. According to this account, explanations are generated via a heuristic process that, as is typical of such processes, overuses information that is easily brought to mind. When answering questions about *why X is (does, has, etc.) Y*, this heuristic process often generates answers couched in terms of the inherent features of *X* and *Y*, features that tend to be highly accessible and are thus oversampled.

In addition to uncovering some of the mechanisms involved in generating explanations, the inherence heuristic account has implications for other phenomena of interest to social and behavioral scientists. I end by briefly highlighting some of these connections, each of which may become a productive line of research in its own right over the next few years.

ISSUES FOR FUTURE RESEARCH

THE INHERENCE HEURISTIC AS A PRECURSOR OF ESSENTIALISM

Stereotyping, prejudice, and discrimination pervade human societies. Although these phenomena are without doubt multiply determined, at least part of the reason for their prevalence is that they are firmly rooted in our natural ways of conceiving of social groups. To be more specific, people conceive of many social categories as consisting of individuals that share a deep *essence* that makes them fundamentally similar, despite any surface differences they might display (for reviews, see Gelman, 2003; Dar-Nimrod & Heine, 2011). This essentialist worldview promotes thinking of members of a social group as interchangeable copies of one another, which in turn facilitates stereotyping (e.g., Bastian & Haslam, 2006). And, when the stereotypes are negative, prejudice and discrimination invariably follow (e.g., Williams & Eberhardt, 2008). Although essentialism is a well-established cognitive phenomenon with significant consequences for social behavior, relatively little is known about its origins. Why do people essentialize? The inherence heuristic proposal might shed some new light on this question. Because the explanatory heuristic hypothesized here leads to a reliable tendency to explain patterns in the world in terms of inherent features, it is possible that it also contributes to the development of essentialist beliefs, which are about a special sort of inherent feature (for the full argument, see Cimpian & Salomon, 2014a, 2014b).

THE INHERENCE HEURISTIC AS A PROMOTER OF BELIEFS THAT DEFEND THE STATUS QUO

Status hierarchies do far more than just organize the social world: Whether an individual belongs to the higher or the lower strata of society has dramatic consequences for that individual's quality of life, with lower societal rank being associated with poorer health, shorter life spans, and other undesirable outcomes (e.g., Pappas, Queen, Hadden, & Fisher, 1993). Despite these stark inequities, many people—including those low in socioeconomic status—believe that the societal structures in which they are embedded are natural and legitimate rather than unfair and in need of overhaul (e.g., Jost, Banaji, & Nosek, 2004). According to current theories in social psychology, this striking tendency to defend the status quo has motivated roots. That is, people *want* to adopt system-justifying views because doing so alleviates their anxiety about their place in society: If the system is fair, then one need not feel guilty about one's privileged position or frustrated about one's disadvantaged position in the social hierarchy.

While the soothing effect of system-defending beliefs undoubtedly makes them easier to adopt, I suspect that this account underestimates the role of

explanatory processes in constructing such beliefs. As in many other aspects of their lives, people probably seek to understand why their societies are structured as they are. Such questions are incredibly complex, of course, and as a result many of the explanations generated in response to them are likely to stem from heuristic processes such as the hypothesized inherence heuristic. However, if people rely on something like the inherence heuristic to explain their sociopolitical systems, then they may end up with beliefs that justify these systems even in the absence of motives to reduce anxiety. This is so because the output of the inherence heuristic will typically frame existing societal patterns (e.g., men are the leaders) as emerging from the inherent features of these patterns' constituents (e.g., men are strong-willed and unemotional). In turn, these sorts of explanations provide a reasonable basis for beliefs that explicitly defend the status quo (e.g., it seems natural and fair that men are in charge).

In summary, I am proposing that heuristic explanations promote a tendency to endorse current societal arrangements. Examining the relative influence of explanatory versus motivated factors in the emergence system-justifying attitudes should provide a fruitful agenda for future work on this topic.

THE INHERENCE HEURISTIC AS A PSYCHOLOGICAL ACCOUNT OF KEY TRANSITIONS IN THE HISTORY OF SCIENCE

Given that the inherence heuristic is a prolific source of explanatory intuitions, at some level it may also be involved in the process by which *scientific* explanations are generated. Although scientific reasoning is arguably more self-conscious and reflective than everyday reasoning, explanation in formal scientific contexts may nevertheless exhibit vestiges of the less-reflective heuristics that shape people's understanding in ordinary contexts. Moreover, it is possible that these vestiges are especially noticeable when a scientific field is in its infancy—which is when its practitioners may be particularly likely to rely on their raw intuitions to make the first explanatory inroads. Thus, examination of the historically early explanatory frameworks within particular disciplines (e.g., physics, medicine) might reveal that they appeal to inherent factors more often than later frameworks. This is not to say that early scientific theories are less thoughtful than later ones. Rather, the claim here is simply that one's basic explanatory intuitions may end up exerting a more noticeable influence on one's scientific thinking if these intuitions are not reined in by the evidence accumulated by previous practitioners. This claim is also not deterministic. Obviously, science is not a march toward ever-more-extrinsic explanations. However, if the present conjecture is correct, we should nevertheless see a greater preponderance of early inherence-based theories than one might expect otherwise, along with a

reliable tendency for later theories to correct for some of the early inherence bias. In other words, the inherence heuristic framework may be able to provide a cognitive-psychological account of important transition points in the history of science.

To illustrate this claim, consider the progression of theories of motion. According to Aristotelian dynamics, an apple falls to the ground because of the apple's inherent downward tendency. Newton provided a more extrinsic explanation of motion in terms of an external gravitational force; however, he still relied on concepts such as *mass*, a property inherent to physical objects, to explain the origin of this force. Finally, Einstein explained objects' movements in terms of factors completely extrinsic to the moving objects themselves, such as the curvature of space. By culling explanations such as these from the history of multiple scientific fields, future research will be able to test the provocative hypothesis that many major advances in scientific thought can be characterized as moving beyond a set of initial inherence-based assumptions.

CONCLUSION

Explanations are fundamental to human psychology. To date, however, the empirical literature has had relatively little to say about the process by which people come up with explanations. Bringing to bear the evidence from the reasoning literature on this problem, the account described here proposes that people generate explanations via a heuristic process that ends up over-relying on inherent facts because they are easily accessible in memory. Aside from its contribution to the field's theoretical toolkit, this new perspective has implications for the (many) social and cognitive phenomena that are informed by explanatory intuitions. Comprehensive tests of the inherence heuristic model, and well as of the connections between the inherence heuristic and these other phenomena, could prove to be a fruitful agenda for the next phase of research on explanation.

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