Synthese (2011) 178:237–270
DOI 10.1007/s11229-009-9542-8

Information theory, evolutionary computation, and Dembski's "complex specified information"

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Received: 23 March 2009 / Accepted: 25 March 2009 / Published online: 16 April 2009

Abstract Intelligent design advocate William Dembski has introduced a measure of information called "complex specified information", or CSI. He claims that CSI is a reliable marker of design by intelligent agents. He puts forth a "Law of Conservation of Information" which states that chance and natural laws are incapable of generating CSI. In particular, CSI cannot be generated by evolutionary computation. Dembski asserts that CSI is present in intelligent causes and in the flagellum of *Escherichia coli*, and concludes that neither have natural explanations. In this paper, we examine Dembski's claims, point out significant errors in his reasoning, and conclude that there is no reason to accept his assertions.

Keywords Information theory · Evolutionary computation · Artificial life · Pseudomathematics · Complex specified information

1 Introduction

In recent books and articles (e.g., Dembski 1998, 1999, 2002, 2004), theologian and mathematician William Dembski uses a semi-mathematical treatment of information theory to justify his claims about "intelligent design". Roughly speaking, intelligent

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design advocates attempt to infer intelligent causes from observed instances of complex phenomena. Proponents argue, for example, that biological complexity indicates that life was designed. This claim is usually presented as an alternative to the theory of evolution.

Christian apologist William Lane Craig has called Dembski's work "groundbreaking" (Dembski 1999, blurb at beginning). Journalist Fred Heeren describes Dembski as "a leading thinker on applications of probability theory" (Heeren 2000). However, according to a 2006 search of MathSciNet, the American Mathematical Society's online version of *Mathematical Reviews*, a journal that attempts to review every noteworthy mathematical publication, Dembski has not published a single paper in any journal specializing in applied probability theory, and a grand total of one peer-reviewed paper in any mathematics journal at all. Dembski's CV (available at http://www.designinference.com) lists another paper in *Journal of Statistical Computation and Simulation* in 1990 that was not reviewed by *Mathematical Reviews*. These papers have received very few citations, suggesting the lack of mathematical impact. For more details, see Shallit (2004).

University of Texas philosophy professor Robert Koons (2001) called Dembski the "Isaac Newton of information theory." However, according to *Mathematical Reviews*, Dembski has not published any papers in any peer-reviewed journal devoted to information theory, although recently he has made available some preprints dealing with this topic on his website.

Is the effusive praise of Craig, Heeren, and Koons warranted?

We believe it is not. As we will show, Dembski's work is riddled with inconsistencies, equivocation, flawed use of mathematics, poor scholarship, and misrepresentation of others' results. As a result, we believe few if any of Dembski's conclusions can be sustained.

Many writers have already taken issue with some of Dembski's claims (e.g., Fitelson et al. 1999; Pigliucci 2000, 2001; Wein 2000; Roche 2001; Edis 2001; Wilkins and Elsberry 2001; Godfrey-Smith 2001; Shallit 2002; Elsberry and Shallit 2003; Perakh 2004; Young and Edis 2004; Forrest and Gross 2004; Olofsson 2007). In this paper, we focus on the mathematical aspects of Dembski's work that have received comparatively little attention thus far.

Here is an outline of the paper. First, we summarize what we see as Dembski's major claims. We examine his generic chance elimination argument (GCEA) and briefly show how it is flawed. We then turn to one of Dembski's major concepts, "complex specified information" (CSI), arguing that he uses the term inconsistently and misrepresents the concepts of other authors as being equivalent. We criticize Dembski's concepts of "information" and "specification". We then address his "Law of Conservation of Information", showing that the claim has significant mathematical flaws. We then discuss Dembski's attack on evolutionary computation, showing his claims are unfounded.

Some of the criticisms in this paper have already appeared in an abbreviated form (Shallit 2002) and in a more popular treatment (Young and Edis 2004).