The Nature of the Arguments for Creationism, Intelligent Design, and Evolution

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Published online: 25 February 2017
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Abstract Seventy-two Internet documents promoting creationism, intelligent design (I.D.), or evolution were selected for analysis. The primary goal of each of the 72 documents was to present arguments for creationism, I.D., or evolution. We first identified all arguments in these documents. Each argument was then coded in terms of both argument type (appeal to authority, appeal to empirical evidence, appeal to reason, etc.) and argument topic (age of earth, mechanism of descent with modification, etc.). We then provided a quantitative summary of each argument type and topic for each of the three positions. Three clear patterns were revealed by the data. First, websites promoting evolution were characterized by a narrow focus on appeals to empirical evidence, whereas websites promoting creationism and I.D. were quite heterogeneous in regards to argument type. Second, websites promoting evolution relied primarily on a small number of empirical examples (e.g., fossils, biogeography, homology, etc.), while websites promoting creationism and I.D. used a far greater range of arguments. Finally, websites promoting evolution were narrowly focused on the topic of descent with modification. In contrast, websites promoting creationism tackled a broad range of topics, while websites promoting I.D. were narrowly focused on the issue of the existence of God. The current study provides a quantitative summary of a systematic content analysis of argument type and topic across a large number of frequently accessed websites dealing with origins. The analysis we have used may prove fruitful in identifying and understanding argumentation trends in scientific writing and pseudo-scientific writing.
Introduction

In the USA, proponents of creationism and evolution have repeatedly clashed with each other over issues in the domains of natural history, law, and education (Berkman and Plutzer 2010; Numbers 2006; Scott 2009). The term “creationism” refers to a doctrine, but the term may also refer to a social phenomenon defined by its members, activities, and goals. As a social phenomenon, creationism shares few characteristics with the social enterprise-known science. Most scientists work for the government or research universities. They spend their days engaged in writing grants, conducting research, writing manuscripts, presenting findings at conferences, training graduate students, etc. A primary motivation for scientists is achieving breakthroughs in understanding the natural world. In contrast, creationist activities involve a great deal of communication aimed at members of sympathetic religious groups and very few attempts at engaging scientists in scientific journals or at scientific conferences. In general, the goals of creationists (including neo-creationists such as the group that self-identifies as proponents of intelligent design (I.D.)) are cultural, moral, political, and theistic. A primary goal of creationists has been to change the educational standards of publicly funded schools (Scott 2009). Organizations such as the Institute for Creation Research (ICR) are very open about the fact that their goals are cultural and religious in nature (Institute for Creation Research 2016). Neo-creationist organizations such as the Discovery Institute have been less forthcoming about their goals; however, their “wedge document” (see Forrest 2001) and their own response to criticisms of that document (Discovery Institute 2003) indicate that their primary goals are cultural and religious in nature.

Though we claim that the various creationisms (e.g., young earth creationism, old earth creationism, “scientific” creationism, neo-creationism, etc.) are pseudo-scientific social phenomenon, we do not claim that there are any necessary and sufficient criteria that can be used to distinguish all examples of science from all examples of pseudo-science. We do, however, agree with Boudry and colleagues that pseudo-science is a descriptively valid term that describes a number of groups that (A) share a number of common features, (B) claim to be part of science, and (C) do not have “the epistemic rigor of genuine science” (Boudry et al. 2015; see also Pigliucci and Boudry 2013).

Now that we have made the case that proponents of evolution and proponents of creationism engage in different activities and have different goals, we must justify why we think that comparisons of the two groups may be both appropriate and valuable. One obvious connection between the two groups is that they both make truth claims about non-religious issues including the origin of species and the age of the earth. Additionally, the two approaches have been forced into conflict when proponents of creationism have sought to replace (e.g., Epperson vs. Arkansas) or supplement (e.g., McLean vs. Arkansas Board of Education; Edwards vs. Aguillard; Kitzmiller v. Dover) the teaching of evolution in public schools. When proponents of creationism attempt to shoehorn creationist teachings into science curricula, the proponents of evolution react and resist such attempts. Finally, both mainstream scientists and so-called creation scientists make the claim that they are doing science (Scott 2009). Given these three connections (i.e., overlapping and conflicting truth claims, antagonistic behavior, and claims to be engaged in science), we feel that it is only natural that researchers would want to explore the ways in which the two groups differ. While there are many approaches available for a researcher interested in comparing creationism with evolution, the particular approach we are interested in is focused on the rhetoric used by each camp. There is only limited scholarship that explores the differences and similarities in the rhetorical approaches employed by each...
group. We do not know if proponents of each of these viewpoints argue their respective cases using identical or widely divergent rhetorical strategies. For instance, we do not know if books written to promote creationism rely on empirical facts with the same relative frequency as books written to promote evolution.

Our strategy is not to simply compare creationism with evolution, but our aim is to explore the similarities and differences of three positions: creationism, intelligent design (I.D.), and evolution. Numbers (2011) and proponents of I.D. have claimed that creationism and I.D. are distinct categories. However, a strong case has been made that I.D. is simply a marketing strategy for creationism and that creationism and I.D. ought to be treated as a single category (Scott 2009; Pennock 2003). Intelligent design creationism appears to be a rebranding of traditional creationism in response to Edwards vs. Aguillard. Scott (2009) claims that the I.D. movement is a form of neo-creationism, with a goal of eliminating creation science terminology in order to get around the legal hurdles that have kept creation doctrine out of public schoolrooms. If this is true, then rhetoric, not fundamental differences in belief, is what we might expect differentiates traditional creationism from the I.D. movement. Whether the I.D. movement is distinct from creationism (as members of the movement claim), or the I.D. movement is only a rebranding of traditional creationism, we might expect proponents of I.D. to employ unique rhetoric. For this reason, we feel that a separate treatment is warranted.

The rhetorical strategies used by these three groups may be of some interest for several reasons. First, information about the style and content of arguments used by the three groups may provide information about the ability of a communicator to recruit new members to the group. Second, information about the style and content of arguments may reveal factors that serve to maintain the belief of the already converted in the face of opposing arguments. Third, information about the style and content of the arguments may reveal the communicators’ conscious or unconscious assumptions about which types of arguments are most likely to achieve their goals. Finally, information about the style and content of the arguments might reveal important similarities or differences between the three groups. The differences among the three groups we have concerned ourselves with (creationism, I.D., evolution) may be of particular importance because of the importance that scientists and certain religious groups place on what should be taught in public schools. Allmon (2011) writes that what is needed in dealing with the non-acceptance of evolution are such things as “better communication of empirical evidence for evolution, more effective explication of the nature of science, and explicitly addressing the numerous significant psychological obstacles that evolution presents to many (perhaps) most people” (see also Kampourakis 2014). We hope that the results of the present study might, in some measure, contribute to these goals.

A number of scholars have studied the rhetoric used by proponents of creationism and evolution. However, many of the publications in this vein have focused only upon the communication of one of the three groups of interest. Haarscher (2009) documented the changing rhetorical approaches employed by proponents of creationism while Ceccarelli (2011) revealed some of the framing tactics employed by proponents of creationism. Campbell (1989, 1990, 1997) and Hodge (1977) have explored the rhetoric employed by Darwin. Lyne and Howe (1997) explored the rhetoric used by Niles Eldredge and Stephen Gould to promote punctuated equilibria. Boudry et al. (2010) documented the manner in which proponents of I.D. equivocate when using the term “irreducible complexity.”

But not all such research has been focused primarily on communication from members of a single group. Weaver (1997) analyzed the rhetoric employed by both sides of the Scopes trial. Pennock (1996) focused on a description of naturalism offered by Phillip Johnson (a proponent
of ID), and contrasted Johnson’s description with the way in which naturalism is understood by the scientific mainstream. Stempien and Coleman (1985) performed a content analysis of both pro-creationism and pro-evolution communications. They relied primarily on transcripts of four different creationism vs. evolution debates and used the seven categories of propaganda described by Lee and Lee (1939).

The current study is an attempt to analyze the rhetoric of argumentation used by contemporary proponents of creationism, I.D., and evolution. Because we are interested in the arguments marshaled by members of these three groups, our plan was to view each argument through the lens of Toulmin’s (1958) Model of Argument, in which each argument can be segmented into two primary components: data and claim. For instance, the argument “humans and dinosaurs coexisted on earth, because fossilized human foot prints have been found mixed in with fossilized dinosaur footprints in the limestone beds of the Paluxy River” would be separated into data (“fossilized human foot prints have been found mixed in with fossilized dinosaur footprints in the limestone beds of the Paluxy River”) and a claim (“humans and dinosaurs coexisted”). The data of each argument can then be coded in terms of type of argument (e.g., appeal to reason, appeal to authority, appeal to empirical evidence, etc.) while the claim of each argument can be coded in terms of topic addressed (e.g., age of earth, common ancestry, mechanism of speciation, etc.). It was our goal that the approach we used in analyzing the arguments would be both quantitative and generalizable. Our approach is quantitative in that it allows for simple frequency counts of argument types and topics that can help us identify patterns in the material of interest. We hope that our approach is generalizable, in that it may be used to analyze and compare arguments employed in documents promoting a wide range of scientific and pseudo-scientific topics.

A number of other researchers have also employed Toulmin’s model in order to categorize science and science-related arguments. Basel et al. (2013) used the Toulmin approach to determine the structures and strategies of arguments employed by students in a German secondary school. Basel et al. (2014) used the Toulmin approach to determine the content, direction, and type of arguments employed by German secondary students. One of the goals of Jiménez-Aleixandre et al. (2000) was to use the Toulmin approach to understand the discourse patterns that students employ in discussion groups. Erduran et al. (2004) used the Toulmin model to analyze arguments generated by classrooms of English secondary school students. However, Toulmin’s model is not the only popular approach to categorizing arguments. Walton (1996, 2006) has also developed a popular system of argument taxonomy. Walton’s approach differs from Toulmin’s in that the claims and data of the Toulmin model are comparable to the premises and conclusions in Walton’s approach. Walton (1996, 2006) proposed a series of argument schemes (e.g., argument from sign, argument from expert opinion; argument from analogy) that correspond to what we refer to as argument types. Though the approach we have adopted is based on Toulmin, we will show how several of our argument types correspond to Walton’s argument schemes.

While the Internet has in no way replaced books or other forms of physical media, it is increasingly an avenue that individuals rely on in order to gain information. We have therefore chosen not to analyze books such as Charles Darwin’s Origin of Species or Michael Behe’s Darwin’s Black Box. Instead, the materials that we have selected for analysis are frequently accessed websites containing arguments promoting one of three positions: creationism, I.D., and evolution. The particular approach to textual analysis we have used has not been employed before, so the current research is descriptive in nature.
2 Method

In order to describe and evaluate the persuasive arguments used to promote creationism, I.D., and evolution, we compiled a collection of Web documents. Our sample of Web documents was restricted to documents whose primary goal was to provide evidence or arguments in favor of one of three positions on origins. To that end, we identified a group of Web pages whose explicit goals were to persuade the reader of one of three things: (1) scientific creationism is true, (2) I.D. is true, or (3) evolution is true. In selecting our sources, we chose 15 different combinations of words and phrases related to the creationism/evolution debate (see Table 1) and then used Google to conduct searches for each of these. For each search, we evaluated only the top 100 hits and selected Web pages that focused primarily (>50% of the site’s content) on one of the three goals listed above.

We developed a set of policies for excluding certain types of content, and we did so prior to collecting data or analyzing any content. First, we excluded from consideration audio and audio/visual content (e.g., audio files, audio streams, tube videos) because it was our desire to focus solely on written communication. We also excluded sermons and sites that claimed that creationism/I.D. was true based solely on biblical or religious reasons. We were interested in comparing scientific arguments with pseudo-scientific arguments. While a study comparing religious arguments to both scientific and pseudo-scientific arguments would undoubtedly yield interesting results, such a study was outside the scope of the current research. We also had a policy of excluding peer-reviewed journal articles; however, this policy was never activated because peer-reviewed articles did not appear in the top 100 items on Google search. Finally, we excluded books and documents over 20,000 words in length. The exclusion based on these criteria was done for practical reasons: coding arguments in extremely long documents would be very time consuming. The set of websites we selected included 72 sites: 34 that promoted creationism, 15 that promoted I.D., and 23 that promoted evolution. Because the content of Web documents changes over time, the content of each of the Web pages was copied and pasted into a text document. All coding and analysis was based on the content in the saved text documents.

Prior to exploring the 72 documents of interest, Rebecca Church, Daniel Drebbing, and Ralph Barnes developed a coding rubric for the position of each website’s author for seven issues (see Table 2). We decided to include Mechanism for Speciation as separate and distinct

| Table 1 | Search terms used to locate the 72 documents |
|---------|-------------------------------------------|
| 1       | Evolution + creationism                   |
| 2       | Intelligent design                        |
| 3       | “Arguments for evolution”                 |
| 4       | “Arguments for creation” OR “arguments for creationism” |
| 5       | “Arguments for intelligent design”        |
| 6       | “Proofs for creationism” OR “proofs for creation” |
| 7       | “Proof of special creation”               |
| 8       | “Proofs of Darwinism” OR “proofs for evolution” |
| 9       | “Proofs for intelligent design” OR “proofs for ID” |
| 10      | “Evidence for evolution” OR “evidence of evolution” |
| 11      | “Evidence for creation” or “evidence of creation” |
| 12      | “Evidence for intelligent design” OR “evidence of intelligent design” |
| 13      | “How evolution is wrong” OR “why evolution is wrong” |
| 14      | “How creationism is wrong” OR “why creationism is wrong” |
| 15      | “How intelligent design is wrong” OR “why intelligent design is wrong” |
from Mechanism for Descent with Modification (DWM) because proponents of evolution (but not some proponents of Creationism and I.D.) feel that descent with modification is an explanation for the origin of species. Any website that rejected the reality of descent with modification would have no opinion on the mechanism of descent with modification. Even websites that deny descent with modification agree that there must have been some mechanism or event that caused individual species to arise. Additionally, Church, Drebbing, and Barnes developed a coding rubric for the goal of each website (pro-creationism, pro-I.D., pro-evolution) in order to capture which of the three positions the website was seeking to promote.

Using Toulmin’s (1958) Model of Argument, each argument had to contain at least two components: data and claim. Prior to coding the type and topic of each argument, the arguments were divided into their data and claim components. Other aspects of Toulmin’s argument structure (e.g., warrant, backing, qualifier, etc.) were not relevant to the coding and were not used. The rubric specified that the type of argument would be found in the data, and the topic of the argument would be found in the claim. Church, Drebbing, and Barnes developed a rubric for argument type and topic using book chapters, pamphlets, flyers, magazine articles, and websites rejected from inclusion in the main study.

A list of the codes for argument type can be found in Table 3. Samuel Draznin-Nagy and Ralph Barnes initially coded the arguments using the category Reason instead of the five reason subcategories seen in Table 3. Before any coding had begun, we expected that some differentiation would be needed for the category Reason. It was planned that if subdivisions of the Reason category were called for, they would be created after an initial coding pass through the data. After the first pass, Draznin-Nagy and Barnes created the five subcategories of reason seen in Table 3 and then made a second pass through the arguments. In this second coding pass, Draznin-Nagy and Barnes coded each item that had been previously coded simply as Reason, into one of the five subcategories of Reason.

| Position of website’s author | Coding options          |
|-----------------------------|-------------------------|
| Age of Earth (lowest $\kappa = .85$) | Young  |
| Descent with modification (lowest $\kappa = .95$) | Old |
| Did not know or not specified |
| Did not happen  |
| Did happen  |
| Do not know or not specified |
| Mechanism for descent with modification (lowest $\kappa = 1$) | Intelligent supernatural |
| Intelligent unspecified |
| Natural  |
| Do not know or not specified |
| Mechanism for speciation (lowest $\kappa = .9$) | Intelligent supernatural |
| Intelligent unspecified |
| Natural  |
| Do not know or not specified |
| Biblical flood (lowest $\kappa = .97$) | Occurred |
| Did not occur or not specified |
| Biblical origin of human life (lowest $\kappa = .88$) | Yes |
| No or not specified |
| The bible is literally true (lowest $\kappa = .97$) | Yes |
| No or not specified |

The $\kappa$ statistic is a measure of rater agreement.
The first two categories listed in Table 3 are examples of appeal to authority, or *ad verecundiam*. In Walton’s (1996) terms, these argument types are referred to as argument from expert opinion. Appeals to clergy and religious texts were classified as Authority: Religious. Appeals to scientists as well as appeals to creationist and I.D. researchers were coded as Authority: Science. Our choice in coding appeals to creationist and I.D. researchers as Authority: Science does not imply that we feel that these individuals are scientists. We simply wanted to reflect the intent of the authors. If the author of a particular document felt that Henry Morris, Duane Gish, or Michael Behe were scientists, then Authority: Science best reflected intent of author. In the scientific literature, citations are to be expected, and yet citations in the scientific literature generally represent appeal to empirical evidence rather than an appeal to authority. In science, what matters are the results and methods described by the researcher, not the mere fact that the researcher made a particular claim. Therefore, a claim attributed to a scientist was assumed to be an appeal to empirical evidence unless the text made it clear that the claim was an appeal to a scientist’s authority rather than research.

Appeal to empirical evidence was broken down into two subcategories: presence and absence. The code Empirical: Presence was used to code for instances in which the claim was based on an empirical discovery (e.g., a particular fossil, therefore …) whereas the code Empirical: Absence (similar to *argumentum ignorantiam*) was used to code for instances in which the claim was based on the failure to find empirical evidence (e.g., no missing links have been found, therefore …). Our two categories (presence, absence) of appeal empirical evidence could correspond to a number of Walton’s (1996) argument schemes, including argument from sign, argument from correlation to cause, and argument from ignorance. Instances of Appeal to Law involved claims that followed from the mention that a law exists (e.g., because of the second law of thermodynamics, evolution is false). Our category of Appeal to Law is most similar to Walton’s (1996) argument from an established rule.

Items in the larger Reasoning category (items 6 through 10) were created to include such things as deductive reasoning, folk reasoning, informal reasoning, and other forms of data that did not fit the other categories of data found in Table 3. Our reasoning category could correspond to a number of Walton’s (1996) schemes, including appeal to analogy. This category was difficult to define for a number of reasons. To explain, consider the prototypical structure of Empirical: Presence, “Because of some data on biogeography, therefore evolution is true.” In this, and all, examples of Empirical: Presence, the claim does not follow directly from the data. In Toulmin’s terms, the claim follows from the data plus a warrant (which may

| Code for type | General form |
|--------------|--------------|
| Authority: religious | Because Bible/religious figure said so, therefore claim |
| Authority: science | Because a scientist said so, therefore claim |
| Empirical: presence | Because of some observed empirical datum, therefore claim |
| Empirical: absence | Because some empirical datum has not been observed, therefore claim |
| Appeal to law | Because of law X, therefore claim |
| Reason: complexity | Because X is irreducibly complex/has specified complexity, therefore claim |
| Reason: probability | Because our calculations show X to be very improbable, therefore claim. (this is related to the rare earth hypothesis and anthropic principle) |
| Reason: Paley | Because life is like a watch, and a watch implies a watchmaker, therefore claim |
| Reason: trivial | Because matter/life exists, therefore claim |
| Reason: other | Because line of reasoning X, therefore claim |

Table 3  Summary of the rubric for argument type
not have been stated explicitly), and the warrant is generally some type of reasoning (e.g., a particular pattern of biological diversity is evidence for evolution because …). So most or all argument types can be shown to rely, at least partly, on some form of reasoning (often as part of the warrant of the argument). This problem was solved because our rubric specified that items could not be coded as appeals to reason if the items matched one of the other argument types.

The Reason: Complexity category was used to label arguments central to the I.D. movement (e.g., because something biological organism exhibits irreducible complexity/specifies complexity, therefore I.D. must exist/I.D. must be responsible for creating that biological organism). The Reason: Probability category was used to label arguments in which the claim was based on statistical or probabilistic statements. One common example involved the claim that God must have created the earth because of the improbability otherwise of a planet with just the right properties for life. A second common example involved a claim that God must have created life because of how improbable it would be for functional DNA to suddenly appear out of a primordial soup. The Paley’s Argument subcategory of Reasoning takes its name from William Paley’s *Natural Theology or Evidences of the Existence and Attributes of the Deity* (Paley 1802). Paley’s Argument takes the form:

If you find a watch, you assume the existence of a watchmaker. A living organism is like a watch, therefore, if you find a living organism, you should also assume the existence of a creator of that organism.

The Trivial Empirical subcategory of Reasoning was reserved for arguments in which the data presented was empirical in nature but the empirical data was completely unsurprising and did not clearly favor one theory of origins over another (e.g., “life exists” or “matter exists”). We felt that in such arguments (e.g., matter exists, therefore creationism is true), the heavy lifting was being done, not by the empirical evidence, but by some line of reasoning that showed why the existence of life/matter was evidence against evolution and for creationism. In Reason: Trivial Empirical arguments, the chain of reasoning linking the data and claim (to use Toulmin’s terminology, the warrant) was generally not stated explicitly.

The Reason: Other category captured all appeals to reason not captured by the other four reasoning codes. Many of the arguments included in the Reason: Other category would be described as folk reasoning (an admittedly fuzzy category). Arguments in the Reason: Other category included such things as arguments from analogy, arguments from a slippery slope, etc. Among the Reason: Other arguments, there was quite a range in terms of both argument structure and topic. The following is one example of a relatively simple Reason: Other argument:

Either the universe itself is eternal, or something/someone outside of and greater than the universe is eternal. We know that the universe is not eternal, it had a beginning (as evidenced by its expansion). Therefore, God (the something/someone outside of the universe) must exist and must have created the universe.

Here is a more complex example of Reason: Other:

If life is the result of natural processes or chance, then so is thought. Your thoughts—including what you are thinking now—would ultimately be a consequence of a long series of irrational causes. Therefore, your thoughts would have no validity, including the thought that life is a result of chance or natural processes. By destroying the validity of ideas, evolution undercuts even the idea of evolution.

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1 See Stenger (2006) for a more thorough description of this argument type.
The claim for the first example is that God must exist and must have created the universe, while the claim for the second example is that “evolution can’t be rationally accepted.”

A list of the argument topic codes developed by Rebecca Church, Daniel Drebbing, and Ralph Barnes can be found in Table 4. Most of the websites included a title or major heading that specified the claim (e.g., List of Arguments for Why Creationism is True). In some cases, each argument (often organized by bullets or numbers) contained only the data, and it was implied that the claim to be paired with the data could be found in the title or heading of the list of arguments. In many cases, however, a claim was presented as a part of each argument. In some of these cases, the claim presented as part of the argument conflicted with the claim presented in the title or heading of the list of arguments. In order to deal with that situation, when the claim of the heading/title differed from the more proximal claim, our coding depended on the proximal claim. Once Church, Drebbing, and Barnes finalized the codes and rubrics for argument topic, S.D. and R.B. began coding the topic of each argument.

The term “evolution” is often used to describe both descent with modification and the mechanism of descent with modification. In order to deal with this inconsistent use of the term, we used two codes to capture the common meanings of the term evolution. The first topic code, Truth of descent with modification (DWM) described arguments about whether or not modern species evolved from other species and shared common ancestry. The topic code Mechanism of DWM was intended to capture arguments about how descent with modification occurred. Some in the I.D. camp (e.g., Michael Behe, William Dembski) grant that descent with modification has occurred, but claim that an I.D., not mutations and natural selection, has been responsible for descent with modification. Arguments from proponents of creationism or evolution would be labeled Mechanism of DWM if they focused on the ability (or lack of ability) of genetic mutations, natural selection, genetic flow, and genetic drift to provide a plausible mechanism of descent with modification. The third topic code, Age, deals with arguments about the age of the earth, the solar system, or the universe. Biogenesis deals not with the theory of evolution, but with mechanisms for the appearance/creation of the first

| Code for topic | General form |
|---------------|-------------|
| 1 DWM         | Because data, therefore species X and Y descended/did not descend from a common ancestor |
| 2 Mechanism of DWM | Because data, therefore mutations/natural selection can/cannot be responsible for descent with modification |
| 3 Age         | Because data, therefore the earth/universe was created X years ago |
| 4 Biogenesis  | Because data, life must have been created by natural/supernatural means |
| 5 Origin of matter/universe | Because data, matter must have been created by natural/supernatural means |
| 6 God exists  | Because data, therefore God/a Designer exists |
| 7 Biblical creation story | Because data, therefore all living things were created during the 7-day creation week |
| 8 Attribute of person(s) | Because data, we know that John Doe is untrustworthy as a source |
| 9 Epistemological issues | Because data, evolution/creationism/I.D is/is not scientific |
| 10 Argument nullification | Because data, the opposition cannot use data X to support claim Y |
| 11 Other      | Because data, therefore claim. |
living thing. The fifth topic code, Origin of Matter/Universe, captures arguments about the nature (e.g., natural, supernatural) of the origin of all matter or the universe.

The sixth topic, God Exists, captures arguments about the existence of God or the Designer. A clear example of this code would be arguments of the general form: The Bible says that God exists, therefore God exists. According to our coding rubric, we also used the code God Exists for arguments with the general form: Something exhibits evidence of design, therefore we have evidence for God/the Designer. When creating the coding rubric, we considered placing arguments of this type under the category of Mechanism of DWM. However, we felt that a close reading of the text indicated that most of arguments of this type were primarily focused on providing evidence for the existence of God/the Designer. These types of arguments are popular among proponents of both creationism and I.D., and there is a broad agreement among scholars that the primary goal of both movements is religious and supernatural rather than scientific and naturalistic. An additional reason that these arguments were coded as God Exists rather than Mechanism of DWM is their focus on supernatural agency. Phillip Johnson (1990, 1991) has argued that science ought to be broad enough to encompass a search for the supernatural entities. However, it is generally accepted that science does not deal in supernatural causes (Pennock 1996; but see also Boudry 2013) and this therefore distinguishes arguments of the form: Evidence of design, therefore God/I.D., from naturalistic and scientific explorations of the mechanism of descent with modification. Simply put, we feel that the existence of God is the endpoint of these types of arguments, and our coding reflects this.

The seventh type of topic code was reserved for arguments about the accuracy of the details of the biblical creation and/or flood accounts, found in Genesis chapters 1–9. For an argument to be coded Biblical Creation Story, the claim of the argument had to explicitly mention specific details of the biblical creation story (e.g., 6 days of creation, the creation of Adam and Eve, the Garden of Eden, Noah’s flood, etc.). The topic code of Attribute of Person(s) was reserved for arguments about the characteristics (e.g., trustworthiness, motives, religious beliefs) of a particular individual or group of individuals. Arguments with these topics could either support or attack an individual (though attacks were more common). Epistemological issues were the topic code given to arguments about the epistemological standing of any of the three theories of origins (creationism, I.D., evolution). These types of arguments typically focused on whether an approach was scientific or deserved to be labeled as a “theory.” The tenth argument code, Argument Nullification, was used to describe arguments making claims about the effective or fallacious nature of other arguments. These arguments were concerned with establishing which arguments could or could not be used to argue certain conclusions. Finally, any argument that was not a fit for the first ten topic codes was coded as Other.

3 Results

Rebecca Church, Daniel Drebbing, and Ralph Barnes independently coded the author point of view (seven of them) and goal of the author of each of the 72 documents. We used Cohen’s kappa (κ) in order to calculate inter-rater reliability (Cohen 1960). For the seven different author positions, inter-rater agreement between the three coders reached acceptable levels, with the lowest κ value being .85 (see Table 2). Additionally, inter-rater agreement for goal of website was also high, with the lowest κ value being .97. All additional coding was conducted

\[ \text{Cohen's } \kappa = \frac{P_o - P_e}{1 - P_e} \]

See for instance Cole (2007); Numbers (2007); Pennock (1996); Scott (2007, 2009).
by Samuel Draznin-Nagy and Ralph Barnes. The inter-rater agreement for topic reached acceptable levels, $\kappa = .91$. Draznin-Nagy and Barnes did an initial coding of the type data using the rubric created by Church, Drebbing, and Barnes and then did a second pass of the data, recoding only the items previously coded as Reason. The $\kappa$ values for both the initial coding and the coding of items initially categorized as Reason both reached acceptable levels, $\kappa = .91$ and .83, respectively. Finally, the inter-rater agreement for the coding of the subtypes of Empirical: Presence arguments used by proponents of evolution also reached acceptable levels, $\kappa = .9$.

With the exception of the $\kappa$ calculations above, we avoided the use of inferential statistics to analyze our data, and used descriptive statistics only. The authors began the present study with no clear expectations of how the data would turn out, and it is not appropriate to use inferential statistics to test hypotheses developed after the data have been collected. The coding of the goal of each website indicated that there were 34 promoting creationism, 15 promoting I.D., and 23 websites promoting evolution. A summary of the website’s position on each of seven topics can be found in Table 5. As can be seen in Table 5, there are important differences between each of the three document types. Table 5 also reveals quite a bit of variability within the category of creationism. So, while I.D. websites do differ from creationist websites, this should be seen in the context of the fact that, in terms of document position, creationism is the most variable of the three types of websites.

Phillip Johnson has advocated a big tent policy within I.D., in order that the movement can include and represent a large number of evolution dissenters (Scott 2007). The big tent policy stresses that the I.D. movement should remain neutral on such things as the age of the earth, descent with modification, and the biblical flood. Table 5 indicates that this strategy has been fairly successful: many of the I.D. websites were ambiguous on the topics of biblical accuracy, the age of the earth, the biblical flood, and descent with modification. Not all of the 15 I.D. documents were completely neutral, however. Twenty percent of the I.D. websites claimed that the intelligent designer is a supernatural being and 13% made the claim that the Bible is a completely accurate document. Some leaders in the I.D. movement (e.g., Michael Behe) accept the reality of common descent (Behe 1996). However, fully a third of I.D. websites break with Behe and explicitly deny the reality of descent with modification.

Interpreting the document positions presented in Table 5 is made more difficult by the fact that proponents of creationism and I.D. have made deliberate attempts to alter their rhetoric for strategic legal reasons (Cole 2007; Scott 2009). A string of federal court rulings$^3$ have made it clear that religion cannot be taught instead of, or in addition to, science in US public school classrooms. In order to avoid violating such rulings, the authors of the textbook Of Pandas and People (Davis and Kenyon 1993), replaced references to God with references to a more ambiguous intelligent designer (Scott 2009). Because there are numerous examples of rhetoric serving the purpose of inserting creationism and/or I.D. into the public schools (see Scott 2009 for more details), we have no way of knowing if ambiguity in regard to the seven topics in Table 5 indicates that the authors of the websites did not have clear positions or if their ambiguity was a strategic choice.

The frequency of argument types as a function of website goal is presented in Table 6.$^4$ The percentage of each type of argument found in each website is presented in Fig. 1. In Table 6, we risk distorting the data by presenting argument type as a function of the 926 arguments. A

$^3$ These include Epperson vs. Arkansas; Edwards vs. Aguillard; and Kitzmiller vs. Dover.

$^4$ The raw data for argument type and topic can be found at https://doi.org/10.15788/M29G6Q.
Table 5  Frequency of document position on each of seven topics. Percentage for each document goal is in parentheses

| Document goal | Earth age | DWM | Mechanism of DWM |
|---------------|-----------|-----|------------------|
|               | Young     | Old | Not specified    | Did not happen | Did happen | Not specified | Intelligent: supernatural | Intelligent: natural | Non-intelligent: natural | Not specified |
| Creationism   | 22 (65%)  | 1 (3%) | 11 (32%) | 34 (100%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 34 (100%) |
| ID            | 0 (0%)    | 1 (7%) | 14 (93%) | 5 (33%) | 0 (0%) | 10 (67%) | 0 (0%) | 0 (0%) | 0 (0%) | 15 (100%) |
| Evolution     | 0 (0%)    | 22 (96%) | 1 (4%) | 0 (0%) | 23 (100%) | 0 (0%) | 0 (0%) | 0 (0%) | 23 (100%) | 0 (0%) |

| Mechanism of speciation | Biblical flood | Biblical origin of human life | Bible is 100% accurate |
|-------------------------|----------------|-----------------------------|------------------------|
| Intelligent: supernatural | 28 (82%)    | 0 (0%)                      | 20 (59%)               |
| Intelligent: natural    | 6 (18%)      | 0 (0%)                      | 14 (41%)               |
| Non-intelligent: natural| 0 (0%)       | 0 (0%)                      | 13 (38%)               |
| Not specified            | 0 (0%)       | 23 (100%)                   | 21 (62%)               |
| Happened                 | 20 (59%)     | 14 (41%)                    | 13 (38%)               |
| No/not specified         | 0 (0%)       | 15 (100%)                   | 0 (0%)                 |
| Yes                      | 0 (0%)       | 15 (100%)                   | 2 (13%)                |
| No/not specified         | 23 (100%)    | 23 (100%)                   | 13 (87%)               |
| Document goal | Type of argument | Authority: religious | Authority: secular | Empirical: absence | Empirical: presence | Law | Reason: complexity | Reason: Paley | Reason: probability | Reason: trivial empirical | Reason: empirical | Other | Total |
|---------------|------------------|----------------------|-------------------|-------------------|-------------------|-----|-------------------|---------------|-------------------|------------------------|-----------------|-------|-------|
| Creationism   |                  | 34                   | 14                | 99                | 203               | 44  | 8                 | 25            | 26                | 10                     | 175             | 638   |
| I.D.          |                  | 2                    | 3                 | 10                | 17                | 6   | 15                | 23            | 8                 | 2                      | 18              | 104   |
| Evolution     |                  | 0                    | 2                 | 0                 | 173               | 0   | 0                 | 0             | 0                 | 0                      | 9               | 184   |
| Total         |                  | 36                   | 19                | 109               | 393               | 50  | 23                | 48            | 34                | 12                     | 202             | 926   |
single website containing a large number of arguments could exert a disproportionate impact on data summarized in this manner. In Fig. 1, we risk distorting the data by presenting argument type as a function of the 72 documents. A large number of websites with few arguments could exert a disproportionate impact on data summarized in this manner. It is due to these difficulties that the data have been presented in both ways. A quick comparison of Table 6 and Fig. 1, however, indicates that the same pattern of results is revealed in both the table and figure.

One thing that the data make clear is that websites promoting evolution are overwhelmingly reliant on Empirical: Presence arguments. In fact, 94% of the arguments used in websites promoting evolution are of the Empirical: Presence type. This is in stark contrast with creationism and I.D. websites, which feature Empirical: Presence arguments 32% and 16% of the time, respectively. Compared to websites promoting evolution, websites promoting creationism and I.D. use a much wider range of argumentation types. In general, the pattern of argument types used in creationism websites is similar to that used in I.D. websites. The exceptions to this rule include the fact that Reason: Complexity arguments are less common in the creationism websites and both Empirical: Presence and Reason: Other arguments are more common in the creationism websites than in the I.D. websites.

Leaders in the I.D. movement are responsible for promoting the use of the terms “irreducible complexity” and “specified complexity.” However, eight Reason: Complexity arguments appear in creationism websites. This indicates that authors promoting creationism and I.D. engage in some sharing of arguments. Related to this, data in Table 5 indicate that some websites promoting I.D. claim that the Bible is infallible and that the intelligent designer is the God of the Bible. These examples indicate that both the beliefs and rhetoric of proponents of creationism and I.D. overlap.

The frequency of argument topic as a function of website goal is presented in Table 7. The percentage of each argument topic found in each website is presented in Fig. 2. The rationale for presenting the argument topic data in two different forms is the same as described above for the argument type data. A comparison of Table 7 and Fig. 2 indicates that the same pattern of results is revealed in both the table and figure. Ninety-three percent of the arguments found in the pro-evolution websites dealt with the topic of descent with modification. This pattern strongly contrasts with the creationism and I.D. websites, as the former deal with a wide range
| Document goal | Topic of argument | Total |
|---------------|-------------------|-------|
|               | DWM   | Mechanism | DWM | Age | Biogenesis | Origin of matter | God/a Designer exists | Attributes of ID/God | Nature of person(s) | Epistemology | Argument nullification | Other |
| Creationism   | 231   | 24        |     | 45  | 34         | 4                | 70                  | 124               | 27               | 16           | 48            | 15     | 638   |
| I.D.          | 5     | 4         |     | 0   | 1          | 3                | 85                  | 1                 | 4                | 0            | 1              | 0      | 104   |
| Evolution     | 171   | 0         |     | 3   | 0          | 0                | 0                   | 1                 | 3                | 4            | 0              | 2      | 184   |
| Total         | 407   | 28        |     | 48  | 35         | 7                | 155                 | 126               | 34               | 20           | 49            | 17     | 926   |
of topics and the latter primarily focus on the existence of God/a Designer. The creationism and I.D. websites differ nearly as much from one another as they do from evolution websites. While most arguments in I.D. websites are focused on the topic of the existence of God/a Designer, the most popular topic in creationism websites is descent with modification, followed by the attributes (other than existence) of God.

The frequency of nine categories of Empirical: Presence arguments found in evolution websites is presented in Table 8. The data in the table reveal that a mere eight categories (we exclude the category Other here) account for 93% of the Empirical: Presence arguments found in evolution websites. Since there were only 184 total arguments found in the evolution websites, those eight categories account for nearly 88% of all arguments found in websites arguing for the truth of evolution. The same eight categories of evidence in support of evolution that are presented in both Coyne’s (2009) and Dawkins’s (2009) books make up the bulk of the arguments used in the 23 websites promoting evolution. If we go back several decades, we find that Douglas Futuyma (1983)’s Science on Trial: The Case for Evolution also contains the same eight categories of empirical evidence for evolution found in both Coyne’s and Dawkins’ books. The picture emerges that, among proponents of evolution, there is now, and has been for decades, a strong consensus regarding what counts as evidence for evolution. Nothing like this degree of consistency across time and authors can be found in the creationist or I.D. literature. Some proponents of creationism are aware of the problem of inconsistency in the creationist camp. Rosenhouse (2012) reported on a creationist presentation at the sixth annual International Conference on Creationism in which the field of creationism was

Table 8 Frequency of type of evidence appealed to in Empirical: Presence arguments found in pro-evolution documents

| Type of empirical evidence appealed to | Total |
|---------------------------------------|-------|
| Atavisms                              | 1     |
| Bad design                            | 16    |
| Biogeography                          | 17    |
| Embryology                            | 10    |
| Fossils                               | 41    |
| Homology                              | 45    |
| Molecular evidence                    | 8     |
| Present day observation               | 23    |
| Other                                 | 12    |
| Other                                 | 173   |
described as lacking unity and accountability and as being beset with poor quality control in terms of its arguments and “science” (p. 211, 212).

4 Discussion

Our study revealed three major trends. First, websites promoting evolution were more likely to narrowly focus on appeals to empirical evidence, while websites promoting creationism and I.D. were more heterogeneous in their approach to argument type. Two plausible explanations can be put forth for the finding that websites that promote evolution are narrowly focused in terms of both the type of arguments. The first explanation is that the homogeneity found in websites promoting evolution may be due to the formal education that many proponents of evolution receive. Standards set by governments, accrediting bodies, as well as broad agreement among biologists may work to homogenize biology content in secondary school and college. In contrast, when it comes to creationism and I.D., there is no single authority that dictates what should be taught or how it should be taught. Numbers (2006) has documented the diversity of opinions within the creationism and I.D. movements, and Rosenhouse (2012) has noted that creationists are aware of the heterogeneous nature of their movements. A second explanation is that proponents of evolution tend to differ from proponents of creationism and I.D. in terms of their view of the nature of science (NOS). It may be that many proponents of evolution feel that the best way to support a scientific claim is to present positive empirical evidence, while many proponents of creationism or I.D. may feel that the best way to support a scientific claim is to use any type of argument available. Barnes and Church (2013) have found evidence that those promoting creationism and I.D. have adopted a different view of the nature of science than that adopted by those promoting evolution and scientists in general. The two explanations (e.g., education and understanding of NOS) are not mutually exclusive: if different understandings of NOS are responsible for the different pattern of argument types, this could be related to the differences between formal biology education and the informal creationism and I.D. education.

Websites promoting evolution have primarily taken an inductive approach to corroborating theory. Our results indicate that the case for evolution is made primarily by listing empirical evidence that supports it. This pattern is also seen in popular books intended to provide evidence for evolution (Coyne 2009; Dawkins 2009; Futuyma 1983). This pattern of results may speak to the understanding these authors have of the nature of science (NOS). The data suggest that there may be a widespread belief among those promoting evolution that the best way to argue for evolution is to present a list of supporting empirical evidence. In contrast, there seems to be far less consensus regarding to best way to promote creationism and I.D.

The second major finding was that websites promoting evolution relied primarily on a fairly small number of types empirical examples (e.g., fossils, biogeography, homology, etc.), while websites promoting creationism and I.D. did not. The use of a small number of empirical examples might best be explained by the influence of education. As mentioned earlier, a number of high-profile books promoting evolution (Coyne 2009; Dawkins 2009; Futuyma 1983) rely on the same empirical examples as found in our sample of websites. Mayr (2001) in his book explaining evolution uses many of the same examples, and it is likely that most high school and college textbooks also use the same examples.

The third major finding was that websites promoting evolution were narrowly focused on the issue of descent with modification/common ancestry, websites promoting I.D. were narrowly focused on the issue of God’s/the Designer’s existence, and websites promoting
creationism tackled a broad range of topics. For the most part, websites promoting evolution maintained focus on the topic of descent with modification and ignored such issues as the mechanism of descent with modification, the age of the earth, biogenesis, the origin of matter, etc. Both proponents of creationism and I.D. seek to be cloaked in the respectability of science (Numbers 2006; Scott 2009), and so perhaps it is not surprising that they claim to be narrowly opposed to “Darwinism.” However, the wide-ranging topics found in documents promoting creationism indicate that creationists are at odds with more than the theory of evolution. By focusing on the age of the earth, biogenesis, and the origin of the matter and the universe, it is clear that scientific creationists have serious difficulties with chemistry, geology, physics, cosmology, and natural history in general. Scott and Branch (2009) have suggested that the term “Darwinism” is used by creationists in order to suggest that evolution is a “disreputable ideology” rather than a position held because of strength of evidence. We find their arguments convincing, but also suggest that attacking Darwinism, rather than natural science, has another rhetorical advantage. Science has broad popular appeal (Pew Research Center 2015) and it seems likely that any religious movement that came out and proclaimed a broadly anti-science platform would have a difficult time recruiting and maintaining followers.

It is possible that proponents of creationism and I.D. may describe their opponents as Darwinists in particular, rather than scientists in general, so that they may hide from themselves their confusing love-hate relationship with science. In light of the current findings, this form of self-deception via the use of anti-evolution/anti-Darwinism rhetoric may muddy the waters: proponents of evolution may be led to understand that evolution alone is under attack when, in reality, proponents of creationism appear to be directing their attacks at a much wider range of topics.

In selecting the websites for this study, we were interested in choosing websites that are viewed by a large numbers of individuals. To that end, we used what we considered to be search strings that individuals might typically use when searching for evidence about evolution, creationism, or I.D. and then we limited ourselves to considering only the top 100 results for each search. While this method allowed us to select the most popular websites devoted to providing evidence for evolution, creationism, and I.D., it did not guarantee that we would select websites that represent the thoughts of scientific or creationist leaders. After all, anyone with access to the Internet can create a website. As it turns out, however, many of the 72 websites selected for analysis in the present study did contain arguments written by either leaders in the scientific community or leaders in either the creationism or I.D. communities. Among the websites promoting evolution, Richard E. Lenski (evolutionary biologist) and Stephen Jay Gould were among the authors represented, and The University of California Museum of Paleontology and The University of Montana were among the organizations represented. The late Henry M. Morris (founder of Institute for Creation Research), Hugh Ross (founder of Reasons to Believe), Walt Brown (founder of Center for Scientific Creation), and other leaders of the creationism movement are among the content authors of the websites promoting creationism. Michael Behe and William Dembski (both senior fellows of the Discovery Institute) and The Intelligent Design Network of Ohio are among the individuals and organizations represented in the websites promoting I.D. Some, but by no means all, of the 72 websites included in our sample were authored by leaders of one of the three movements.
One limitation is that we have no data on the personal thoughts and motivations of the authors of these documents. While the most frequent argument types in creationist and I.D. websites differ from those used by scientists, it is not clear if this reflects a strategy to optimally influence the intended audience of the websites, a flawed understanding of NOS on the part of the authors, or a combination of both. The list of arguments favoring creationism may have been intended to persuade individuals to accept creationism as an accurate description of natural history. It is also possible that the list of arguments was meant to help those who already accept creationism to resist persuasive attempts by proponents of evolution. This second possibility is referred to as attitude inoculation in the psychology literature (McGuire 1964) and, though none of the website authors indicated attitude inoculation as a goal, it cannot be ruled out. Additional research would be required to determine if the arguments in the 72 websites were intended to persuade readers, inoculate readers, or both. Our study is also limited by our choices of content to analyze: numerous books on origins have been best sellers and many people learn about origins from Internet videos. We also chose to ignore sources promoting biblical creationism. It is likely that analyses of video sources, non-Internet sources, and biblical creationist sources will reveal a great deal of useful information about creationists.

In our introduction, we addressed the fact that creationist organizations have fought to change the nature of public science education. One obvious problem with this agenda is that, were these groups to succeed, school children would be taught false and non-scientific claims about natural history. The current study suggests that the introduction of creationism into the classroom might also lead to a different and perhaps much more important problem: the undermining of NOS among students. We have shown that the arguments employed by creationists do not reflect an understanding of NOS (McCoomas 1998; McCoomas et al. 1998). Driver et al. (1996) and Duschl (2000) have argued that educators ought to address the epistemological basis for conducting scientific inquiry. These authors have stressed that science education ought to help students develop an understanding of the standards, rules, and criteria used to determine what should and should not count as scientific evidence. If students are exposed to creationist textbooks that rely on the same types of creationist arguments documented in the present study, then these students would be exposed to very inappropriate notions of the criterion that scientists rely on. At bare minimum, exposing students to creationist arguments and labeling those arguments as scientific would undermine the ability of students to achieve the educational goals suggested by Driver et al. (1996) and Duschl (2000). Additionally, such an education would likely hinder the ability of students to understand the content of all scientific disciplines and make it very difficult for these students to develop into successful scientists.

The diversity of argument types and topics reported in the current study is consistent with Rosenhouse (2012) who reported on divisions within those opposing evolution and on awareness within the creationism movement of schisms and lack of unity within their organizations. The current study also extends previous efforts to describe the rhetoric of origins. Along with Stempien and Coleman (1985), the current study is one of the few studies on the rhetoric of origins that has employed a systematic and quantitative approach to the rhetoric of evolution, creationism, and I.D. Our taxonomy of argument types might prove useful in uncovering similarities between various pseudo-scientific communities. In future studies, we hope to code arguments in documents from groups commonly referred to as pseudo-scientists (e.g., AIDS denialists, climate change denialists, the anti-vaccine movement) in order to see if the patterns of arguments displayed by these groups bears any similarity to the arguments of proponents of evolution, creationism, and I.D. Future research may determine if there are patterns of rhetoric that are unique to pseudo-science groups.
Compliance with Ethical Standards

Conflict of Interest  The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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