

An Evolutionary Factor Analysis Approach to the Study of Issue-Definition¹

Frank R. Baumgartner
Penn State University
Department of Political Science
University Park, PA 16802-6200
Frankb@psu.edu

Suzanna De Boef
Penn State University
Department of Political Science
University Park, PA 16802-6200
sdeboef@psu.edu

Amber E. Boydston
Penn State University
Department of Political Science
University Park, PA 16802-6200
aboydstun@psu.edu

May 11, 2004

¹Paper prepared for presentation at the Annual Meeting of the Midwest Political Science Association, Chicago, IL, April 15-18, 2004. Copyright by the Midwest Political Science Association. We thank Cheryl Feeley, who was instrumental in the initial stages of the project.

Abstract

We develop a new methodology for the study of how issue-definitions change over time. Based on an intensive study of media attention to the issue of capital punishment in America from 1960 to present, we illustrate and explain the use and value of evolutionary factor analysis. We begin with a comprehensive coding of each occurrence of 65 different arguments that we identified through reading 3,512 abstracts in the *New York Times Index*, representing every article published in the paper on the topic of capital punishment during the past 50 years. Then we explain the use of evolutionary factor analysis, a technique that allows us to trace the evolutionary growth and development of new issue-definitions over time. The approach has broad potential applicability in the areas of issue-definition, framing, and dimensionality in general. We explain how the technique works and what type of data are needed in order to use it. We then compare the results from our new technique to those based on simple article counts of our underlying data set using a simpler content analytic technique.

Data come from a study of capital punishment. We show dramatic changes in the structure and content of media discussion of the death penalty issue over time. First, we show an unprecedented rise in attention to the issue beginning in the late-1990s. More importantly, our new technique reveals empirical evidence of a dramatic new issue-definition in this time period. Whereas the issue has previously been discussed in terms of morality and constitutionality, a new issue-definition based on the possibility of errors in the justice system has arisen since the mid-1990s. Based initially on charges that innocent people may be on death row, our new technique allows us to show that this issue-definition in fact has expanded to include a number of other critiques of the system based on its arbitrary application, racial bias, and other factors. Most importantly, these data show a significant redefinition of the death penalty debate away from the previously dominant moral and constitutional frames. Most Americans support the death penalty on moral grounds. Few, however, support a biased and flawed system. The newly dominant frames of the debate, which we demonstrate clearly here, may be expected to have important implications both for public policy and public opinion in the future.

1 Introduction

The nature and extent of public dialogue on political issues characterizes how issues are defined—how they are framed by politicians and policy advocates and the particular arguments or dimensions that are central to public debate; ultimately issue-definition affects opinions and outcomes. Yet issue-definition is nebulous. We know that it occurs. In fact we often know it when we see it. Yet, efforts to define or identify particular issue-definitions and their evolution over time are lacking in two key aspects. First, they suffer from the imposition of analyst-defined dimensions. Second, they have not systematically assessed key features of the issue-definition process, in particular the evolutionary nature of issue-definitions. We offer a methodology that begins with arguments, the building blocks of issue-definitions, and uses these to estimate the different issue frames that characterize public debate within particular periods of time. Then we use this information to identify common “threads” of these estimated frames over time, thus identifying *evolutionary frames*. We illustrate this methodology and compare its findings to common methods for characterizing issue frames using the death penalty as an example.

2 Measuring Issue-Definition

Issue-definition has been studied in a variety of ways. Most studies can be divided into qualitative and quantitative approaches. Within the qualitative approach, studies have focused on anecdotal narratives, describing issue-definition based on historical records of public attention to issues and providing informative descriptions of utilized frames (Carroll 1999; Cobb and Elder 1983; Hancock 2004 forthcoming; Kingdon 1984; Pollock 1994; Riker 1982; Sparks 1999). In contrast, scholars conducting quantitative studies have typically devised a coding system to count attention to various elements of a given debate (Baumgartner and Jones 1993; Kellstedt 2000; Terkildsen and Damore 1999; Terkildsen and Schnell 1997). So, for example, Baumgartner and Jones (1993) counted articles on such issues as nuclear power, pesticides, and drug abuse. They either coded the articles by their tone (e.g., positive or negative towards the industry in question) or focused on a small number of predefined underlying dimensions (e.g., education and treatment v. enforcement and punishment

in the area of drug abuse).

Much can be said for the previously employed method of comparing how different arguments and groups of arguments become more or less salient (in terms of frequency) in different points in time. Through this method, individual arguments are grouped into “dimensions” based on categories of arguments predefined by our theoretical understanding of the issue, and relative attention to these dimensions (again, in terms of the frequency of article coverage) may be traced over time. Under this approach, dimensions are equated with potential frames, and a dimension is labeled as “dominant” each time the frequency of its component arguments exceeds some designated frequency threshold or each time it exceeds a proportional attention threshold in relation to competing dimensions.¹ This method is likely to yield results that are both intuitively sound and politically interesting, but the approach is insufficient. We argue that counts alone cannot capture the complex workings of issue-definition and offer an approach that more fully matches our understanding of the issue-definition process.

2.1 The Nature of Issue-Definition

In thinking about how issue-definition operates in the political environment, we must consider the features of an issue debate that enable different frames to emerge at different points in time. Two such elements stand out as having primary importance across different instances of issue-definition: saliency and resonance.

In order for an argument or set of arguments to define a debate, these arguments must be made frequently. Yet saliency is not the only mechanism at work in instances of issue-definition. To define a debate, arguments must also be resonant. If an argument resonates, it leads to the increased use of other arguments that can be seen empirically to be related to the other argument. Issue-definition is more likely to occur when argument-sets are both salient and resonant.

¹In our theoretical discussion, we will use the term “dimension” to refer to categories of arguments that are *predefined* by the researcher’s theoretical understanding of the issue and fixed over time. These dimensions are generally small in number and are based around commonly understood core concepts such as morality, economic issues, etc. In contrast, we use the term “frames” (specifically, “evolutionary frames” as we will define it later) to refer to those single arguments or argument-sets which are empirically shown to share dynamic patterns in a period of time, as defined under our proposed method of evolutionary factor analysis. The different frames present in a given time period constitute the components of an issue definition.

2.2 Problems with previous work

Previous quantitative analyses measured the salience of pre-defined dimensions of public discourse, but this approach is limited in two ways. First, it relies on the researchers' judgment calls in identifying individual arguments and groups of arguments as constituting different dimensions, which in turn serve as the assumed fixed set of possible frames which may be observed in this system of analysis. Yet any given issue of significant public policy impact has a great number of possible frames that may combine arguments in a variety of ways. Importantly, not all relevant frames can be known to the analyst *a priori* (which will resonate is not predictable *ex ante*).² Consider an issue such as poverty. How many dimensions of the issue can one think of? Clearly there are elements of the issue relating to education, nutrition, housing, individual motivation, health, the state of the economy, willingness to work, geography, race, class, family size and background, marital status, etc. Any complex issue may have scores of dimensions at least potentially related to it. How any given argument contributes to these different dimensions of debate, how much pull argument-sets will exert or experience, is not always obvious. Yet identifying which arguments are part of which dimensions is a necessary step in this type of analysis.

Second, to examine issue-definition exclusively in terms of the varying frequency of different arguments and dimensions is to ignore a crucial component of issue-definition mechanics: issue-definitions are not only multi-dimensional, but the dimensions themselves are also fluid and may overlap over time. The fluidity results from changes in the resonance of given arguments over time. In a simple case consider that an argument made in isolation, even if repeated many times, is likely to have less overall impact than an argument moving in tandem with other arguments, all pointing in the same direction. For example, previous studies of welfare issues suggest that this debate used to center around providing support to needy families, but in later years was redefined with greater attention to issues of race, to bureaucratic waste, to creating a disincentive to work, and more recently to questions of personal responsibility, as in the 1995 debate over the Personal Responsibility and Work Reconciliation Act. Importantly, arguments about race may be made in each of these definitions. Similarly, pesticides issues were once focused on agricultural productivity, scientific advance, and the war against hunger. Later, they became focused on issues of toxic waste,

²This feature of issue-definitions is what compels qualitative analysis.

the dangers of big agribusiness, and environmental degradation (Baumgartner and Jones, 1993). In both these cases we can understand how the same argument-set made with the same frequency but at two different points in time under different definitions of the issue would be characterized by different weights or resonance.

In other words, if attention builds to a single aspect of, say, welfare reform that makes the policy look more attractive, and there is no spill-over to other similar arguments, the overall impact of this may be low. If, however, attention to one argument leads also to more attention to other arguments that cross fixed and predefined dimensions, the impact on the overall issue-definition may be higher. Further, this would show that issue-definitions are more fluid than previous, count-based analyses suggest. Thus while public attention to an issue at any given time may have only a narrow focus on one or a few arguments, if we look at issues over time, these foci can change dramatically as different arguments resonate with the public; the issue is inherently multi-dimensional even if many debates about it have a low dimensional structure at a given point in time (see Poole and Rosenthal 1997; Jones and Baumgartner 2004) and the composition of these dimensions may be overlapping and fluid. Thus, in order to characterize the evolution of the dimensional structure of public attention, we need to know not only what arguments are part of a particular dimension of attention at any given point in time, but also how the composition of arguments on a particular dimension evolves over time. We will want to look at the degree to which attention to various arguments co-varies, and we will want to be open to the possibility that attention to one fairness argument may statistically lead to more attention to a cognate moral argument; these clusters of argumentation, what we will identify with evolving statistical factors, may cross fixed dimensional lines defined by the analyst. It may be possible to trace these changes by counting attention to the underlying dimensions of debate over time, but to the extent that arguments may be parts of different dimensions in different time periods, tracing changes is no simple task.

In short, examining relative frequencies of arguments or dimensions is the state of the art in the quantitative study of issue-definition, and while this captures the salience of arguments, it is bedeviled by many difficulties. Here we propose a new approach that can complement and improve on previous techniques. The new approach has many virtues but is particularly valuable in its sensitivity to the changing dynamics of issue-definition over time. Since it allows for new

frames to emerge that may differ in their composition over time, the approach is truly dynamic and evolutionary in nature. Previous approaches, even the best ones, are typically more static. In any case, this new approach allows greater flexibility in determining what constitutes a frame, and it attempts to define frames statistically from the shared variance structure of attention to a great number of underlying arguments.

The methodology we propose builds on previous works, relying for much of its purchase on the systematic counts of attention to an exhaustive list of underlying arguments. This measure of argument saliency, however, is just one piece of information about issue-definition. How these arguments are used in conjunction with each other and how argument-sets then evolve over time are important features of issue-definitions. Our methodology identifies the specific argument-sets used at one point in time, the evolution of argument-sets, and how different arguments resonate with each other, all fundamental features of issue-definition. More specifically, we offer an evolutionary factor analysis, which shows how many frames of debate exist at any point in time, what those frames represent, and whether a given frame has attracted or lost new elements over time. In the application to follow, we will show conclusively that dramatic changes have occurred in the area of capital punishment, and most importantly that the rise of a new issue definition, focusing on the possibility of errors in the justice system, has grown now to include a great number of related arguments. These arguments were previously made in the 1960s, 1970s, and 1980s. However, they were made in isolation, unassociated with a broader critique and focused mostly in the context of a moral frame. With the newly emergent issue of innocence and error in the system, these older arguments have re-emerged. More importantly, they are now statistically associated with innocence questions to create a single and newly dominant issue definition. This new frame shifts the debate from one about morality to one about whether it is possible to design a human justice system that can forestall any possibility of error. Our focus in the paper is methodological, but our substantive findings are powerful as well.

3 Laying the Groundwork: Issues, Dimensions, and Arguments

The analysis of issue-definition must begin with an issue, defined simply as any object of public policy debate. We focus here on the death penalty, but the logic is more general. Many arguments can be made—pro, anti, and neutral—about an issue. Some arguments are factual (e.g., public support for the death penalty is on the rise; capital defense trials cost the government a certain number of dollars each year), whereas others are subjective or moral (e.g., killing of any kind is morally wrong, vengeance is justified). Within a single dimension (and frame), numerous arguments can coexist and these can be either complementary (the death penalty deters potential criminals; the death penalty incapacitates criminals from striking again), or they can be contradictory (deterrence effects are strong; deterrence effects are weak). We present the argument list for the death penalty issue within the smaller number of general dimensions of debate, as coded in a project studying *New York Times* coverage of the issue in Appendix One (see Baumgartner, Boydston, and Feeley 2003).³ Each argument must itself be unidimensional, though many debaters or newspaper articles employ more than one argument. In the case of the death penalty, we defined 65 different arguments relating to 7 predefined dimensions of the issue. The dimensions include efficacy, morality, cost, constitutionality, fairness, mode of execution, and international arguments.

The arguments compose the building blocks of any frame. In particular, arguments that move with patterns of shared variation combine to form frames. Frames may be short-lived on the political scene or they may be persistent. We call those frames which are short-lived “non-adaptive frames.” Persistent frames, which we call “evolutionary frames,” share arguments sets over time. These evolutionary frames may be fluid in that the argument set may evolve over time, but maintain a core set of arguments. It is the ability of the evolutionary frame argument-sets to evolve that enable these frames to persist, providing them heightened ability to define or redefine an issue debate. And the more salient the arguments of an evolutionary frame, the more likely issue-definition is to occur.

³It is important to note that the list of arguments laid out in Appendix One is consistent over time. That is, arguments are not defined in historically or context-related terms. For example, there is no argument for “Timothy McVeigh” or any other defendant. No codes are created for any items that are unique historically. Rather, they are all listed in terms of the underlying argument that they raise, and a different code is listed for each distinct argument made. In this way, we can compare the relative prevalence of different arguments over time.

Whether and how arguments combine to form frames is an empirical question. Although the 7 dimensions we have outlined in the death penalty debate are theoretically sound, their parameters are not empirically driven. We want to identify which of the 65 arguments have moved together, and when, in statistically significant ways to form the actual dimensions that have defined the death penalty debate over time. Given a comprehensive database of the occurrence of each of our 65 arguments over time, we use these argument-counts as the inputs of a statistical analysis that will assess the degree to which the individual items aggregate into the larger frames. Below we first lay out and then demonstrate the method we utilize to do just this.

Since this is the first application of these techniques, it is also important that we show the validity of the methodology. Partly, we will accomplish this by showing how the results we obtain are substantively interpretable and correspond to what a knowledgeable observer would expect to see. The results correspond in large measure to those from the simpler content analysis approach with which we begin. That is reassuring. However, the results from our proposed method go beyond those obtained using the simpler approach because they allow us to see the dynamic evolution of issue-definitions over time, a process that is fundamental to the theoretical expectations in the literature, but impossible to assess with the older empirical approach.

4 Evolutionary Factor Analysis

The demands of our theoretical understanding of issue-definition require a method that can identify the dimensional structure of arguments *and* that allows for estimation of how that dynamic structure changes over time. We offer an evolutionary factor analysis approach that meets both of these requirements. In brief, evolutionary factor analysis first employs “dynamic” factor analysis, or factor analysis performed on a given window of time. The dynamic factor analysis identifies the arguments and argument-sets that hang together in that window to form issue-definitions (Kim and Mueller, 1978a,b). Second, we repeat this analysis of moving and overlapping time windows. Third, we develop a set of rules to identify common, but evolving, argument threads across the separate analyses. The results are used to distinguish evolutionary frames from nonadaptive frames by examining which frames recur in adjacent time periods and which disappear. In addition, evolu-

tionary factor analysis traces how the composition of these evolutionary frames evolves over time, providing us with empirically detailed time series of the issue definition of a particular topic. For instance, an evolutionary frame that we might label fairness may contain arguments relating to innocence of the defendant and fairness of the process in one period. In the succeeding period it may additionally include arguments about racism. At another time it might not include the due-process element. Evolutionary factor analysis may be performed on any data set that measures attention over time to a sufficiently large array of arguments related to a single issue over time.

In the following series of steps we provide a detailed description of the evolutionary factor analysis method and how it can be employed to examine how an issue has been framed over time. For clarity of exposition, our discussion revolves around a single issue, the death penalty.

Step 1: Develop a Comprehensive Data Set. Evolutionary factor analysis begins as traditional quantitative studies of issue-definition, with a count of the arguments aggregated to some time interval of interest and sustained by the information in the data. Given the nature of media coverage on the death penalty, we aggregated to annual argument counts. There are simply not enough stories in most months or quarters to warrant aggregating reliably at a finer level of time. Some data sets, however, might lend themselves to a more fine-grained temporal analysis, in which case a day, week, or month time unit may be employed.

Step 2: Perform Factor Analysis on Moving Windows. We use this data set to estimate dynamic factor analyses within windows of time. Factor analysis of argument-counts produces estimates of the dimensional structure of the co-movements in the data within a window. We defined a 5-year time window for the analysis of the death penalty data, tapering windows at the ends of the observation period. The size of the window was selected based both on the nature of the issue and the information available in the data itself. The history of public discourse on the death penalty has evolved relatively slowly and continuously, suggesting that a short time window is not required to capture the changing structure of issue definition. Given this and the extensive but still limited data, a 5 year window seems appropriate. Importantly, we allow the windows to overlap—we identify the dimensions of argumentation used from 1990-1994, from 1991-1995, and so on; this catches shifts in the composition of frames that occur at the level of the year, while

taking advantage of the shared movement in the data over a longer time period. Because data from a single year contributes to five different time window analyses—except at the tails of the data, we are able to trace subtle patterns of movement.⁴ Standard factor analysis is performed on data within each of the overlapping five-year windows.⁵

The analyses produce some number of factors with attendant loadings of all the arguments made in each time window.⁶ In this particular data set, every non-tapered time window produced either 3 or 4 factors, which together explained 100% of the variance of movement. Across windows, the different arguments can combine in any of a large number of ways to compose different factors.

Step 3: Define the number of frames within a time window. The number of factors and the loadings of arguments on each identify the dimensional structure of the argumentation in each window. Strong loadings on a given factor indicate patterns of shared movement among the arguments that shape that dimension of public dialogue. As a practical matter, we separate out those arguments that registered a positive loading from those with a negative loading and call the set of arguments with positive and the set with negative loadings each a frame. The separation is necessary because arguments that load negatively mirror those that load positively, constituting expressly distinct frames. They do not move in tandem; exactly the opposite. Thus if factor analysis identifies 4 frames in a given window, there is a potential for (up to) 8 frames.

Jointly, this procedure gives us the different number of frames competing for attention in any given window and the degree to which any particular argument usage correlates with the dynamics (movement) of that frame within each time window.⁷ We eliminate all loading values for arguments for which, again in a given time window, the shared variation with the hypothetical underlying factor is below a threshold loading of 0.90, under the assumption that these arguments are not central to the frame. In practice, then, the number of frames will be less than two times the number of factors, as some factors are composed only of arguments that load at levels below

⁴We do not conduct a single factor analysis over the full time period because it assumes that the frames do *not* change over time. Such a factor analysis would have an advantage over analyses that predefine the dimensions, but they do not allow for the fluidity of dimensionality that characterizes issues-definition.

⁵In order to place too much emphasis on unreliably small counts (e.g. where the pattern of number of articles attending to many of these arguments within a window might be something like 0,0,0,1,0) we chose to ignore all arguments which, within a given five-year window, appeared in less than a total of 5 abstracts.

⁶Results were reoriented using the “rotate, varimax” command.

⁷The individual eigen values listed for each argument in each factor indicate the level of contribution a given argument makes to that factor.

0.90. Theoretically these omitted frames are “noise”—argument clusters that were used but not strongly associated with a particular dimension or frame in that window.

Step 4: Define the frame content within a given window. In step 3 we defined the composition of a frame as all arguments that load strongly on a frame (defined as having a loading value of 0.90 or greater). The next step is simply to list those arguments that load above this threshold. This listing does not require the analyst to consider the substantive content or valence of the argument. In fact, nothing at all needs to be known about the arguments, but the argument identifier (such as a code number). Thus, we end up with a series of lists of arguments with common patterns of movement: one list for each factor in each time window.

Step 5: Define the evolution of dynamic frames ie, evolutionary frames, across windows. Within each time window, this list of arguments that move together within that window tells us how arguments are framed in that particular time span. In order to capture the fluidity of frames and their content, we want to identify those sets of arguments that not only move together within single time windows, but also dominate the public debate *across* time windows. We hypothesize that these evolutionary frames, by virtue of the shared dynamic movement exhibited by their component arguments over time, gives us the best estimate of the frame contents of the public dialogue on a given issue over a span of time.

Briefly, in order to qualify as an evolutionary frame, an argument or arguments must contribute highly to patterns of shared movement across time. Empirically we define an evolutionary frame as an argument or set of arguments that a) contribute highly to patterns in shared movement in one time window and again no later than the succeeding 2 windows⁸ and b) do not split into separate argument-clusters in a surrounding time window.⁹ More precisely, we perform this identification process under the following guidelines:

1. First, looking at the lists of arguments in each factor in each time window that loaded highly

⁸Because we are working with overlapping time windows, the absence of an evolutionary frame from a single time window does not imply that the evolutionary frame was absent from the public debate in any single year. In practice, small argument counts, for example, may produce a gap. Our rule allows for this occurrence. Thus in practice, an evolutionary frame must exist in two out of three time periods. In all cases where we refer to “consecutive windows”, we make this allowance.

⁹Evolutionary frames that combine and split are thus treated as two separate evolutionary frames for their duration. Alternatively we might choose to call these a single evolutionary frame when they coincide. In our example, this occurs only once in the data.

on that factor, we trace the occurrence of each specific argument, moving both forward and backward in time, identifying arguments as part of an evolutionary frame if they appear in at least two consecutive time windows. So for example, if argument number 203—crime deserves the death penalty—occurs in the 1978, 1980, and 1981 time windows, it is labelled as (part of) evolutionary frame *A*, allowing for the skip in 1979.

2. Next we look to see whether any other arguments are used in tandem with the argument in question, labelling each tandem argument as part of the same evolutionary frame whenever the two arguments appear in the same argument-group in two consecutive windows.

If a component argument of an evolutionary frame continues in successive time windows after the other arguments trail off, it retains the label of that frame. Thus over time, the argument-sets that compose an evolutionary frame may change as additional arguments are incorporated and others no longer exhibit the dynamic patterns unique to that evolutionary frame. Further, arguments that adopt the pattern of movement characteristic of the evolutionary frame but do not do so in consecutive windows are not part of the evolutionary frame. These arguments may add to the significance of at least volume of the evolutionary frame in that time window. Similarly these arguments benefit from the presence/nature of the evolutionary frame, piggy-backing on the salience of that frame. Finally, evolutionary frames that drop out of the public dialogue for multiple years and then reappear are not assumed to be the same frame even if they have similar, but not identical, component arguments.

Step 6: Name the frames. In some ways there is no need to name evolutionary frames; names are not required to answer questions such as “How does the dominant frame affect opinion?” or “Does the valence cut across or coincide with frames?” etc. However, we care about what these frames are because the end goal of applying evolutionary factor analysis to a particular data set is to tell a substantive story about how the issue definition of a topic of interest has evolved over time. We want to be able to characterize these frames, to give them names that accurately characterize the nature of the argumentation that moves together across time.

Frames are likely to consist of several types of component arguments. First are those logically consistent and corresponding to what the analyst may have expected with a traditional content

analytic technique as laid out for example in Appendix One. Second, statistically, a given argument could correspond with its counter-argument (or a neutrally valenced discussion of the same dimension of debate). Third, attention to one argument may spill over to other arguments from other dimensions—that is, it may resonate, leading to more attention to other arguments supporting the same conclusion. (Attention to the racist element of the death penalty can lead to more attention to failures of due-process, for example.) Finally, of course, there may be some random elements though our threshold of .90 loading and requirement that the frames occur twice in succeeding time windows can be expected to limit this dramatically.

Step 7: Introduce salience. Thus far in the process of evolutionary factor analysis we have been concerned solely with identifying which arguments and sets of arguments share common patterns of dynamic movement across time. These threads of shared motion are essential components of the issue-definition process, and are precisely what was lacking in previous empirical studies of the topic. Indeed, we suggest defining a frame exclusively in terms of which arguments contribute highly to shared patterns of movement, making no distinction between those arguments that receive heavy volumes of media attention and those which appear less frequently. Yet the frequency with which these frames are employed in the public dialogue of an issue is an equally important component in the process of issue-definition. We use the salience in combination with the strength of each argument on a given frame to characterize the overall weighted composition of the evolutionary frame. In particular, we take the product of the loading and counts for each component argument of all frames in all windows. Arguments with loadings below 0.90 receive a zero and thus do not receive salience weights. Finally, we sum these loading-count products within frames to produce the overall weighted attention to each evolutionary frame.¹⁰ The resulting values produce a single value for that frame in each time window of its existence. We graph and discuss the evolutionary frames identified for the death penalty below.

¹⁰More practically, we take the streamlined columns of data now containing only the factor loading values for those variables which loaded highly (0.90 or above) on a factor in a given time window (distinguishing positive from negative loadings) and we multiply each data cell by the total number of times the corresponding individual argument was made in the *New York Times* in the given time window. thus arguments loading below 0.90 do not contribute to the weighted composition of the evolutionary frame.

5 Data and Results: New York Times Coverage of the Death Penalty

To present an example of evolutionary factor analysis in action, we employ a data set utilized in our ongoing research of how capital punishment has been presented to the American public over time. For this project, we coded the specific arguments made for and against capital punishment in the abstract of every *New York Times* article published on the death penalty from 1960-2002.

Before showing results yielded from using evolutionary factor analysis, we briefly discuss the more straightforward findings obtained by examining only the frequency counts across arguments, as previous quantitative work on issue-definition has done. Beginning from a bird's eye view, Figure 1 shows the total amount of attention given to the capital punishment debate (calculated as the number of articles written on the subject) across time, while Figure 2 shows the net number of abstracts with a pro-death penalty valence (calculated as the number of abstracts coded as pro-death penalty minus the number coded as anti-death penalty). Already, this data provides useful information for examining how the death penalty debate has changed over the years. Most notably, we see that attention to the topic has tended to increase over time, with an unusually large explosion of attention in the last two years of the time series. We also observe that the direction of common valence has changed dramatically at different points over time. In particular, we see a dramatic decrease in pro-death penalty valenced abstracts (thus indicating a steep rise in number of anti-death penalty stories) beginning in the late 1990s.

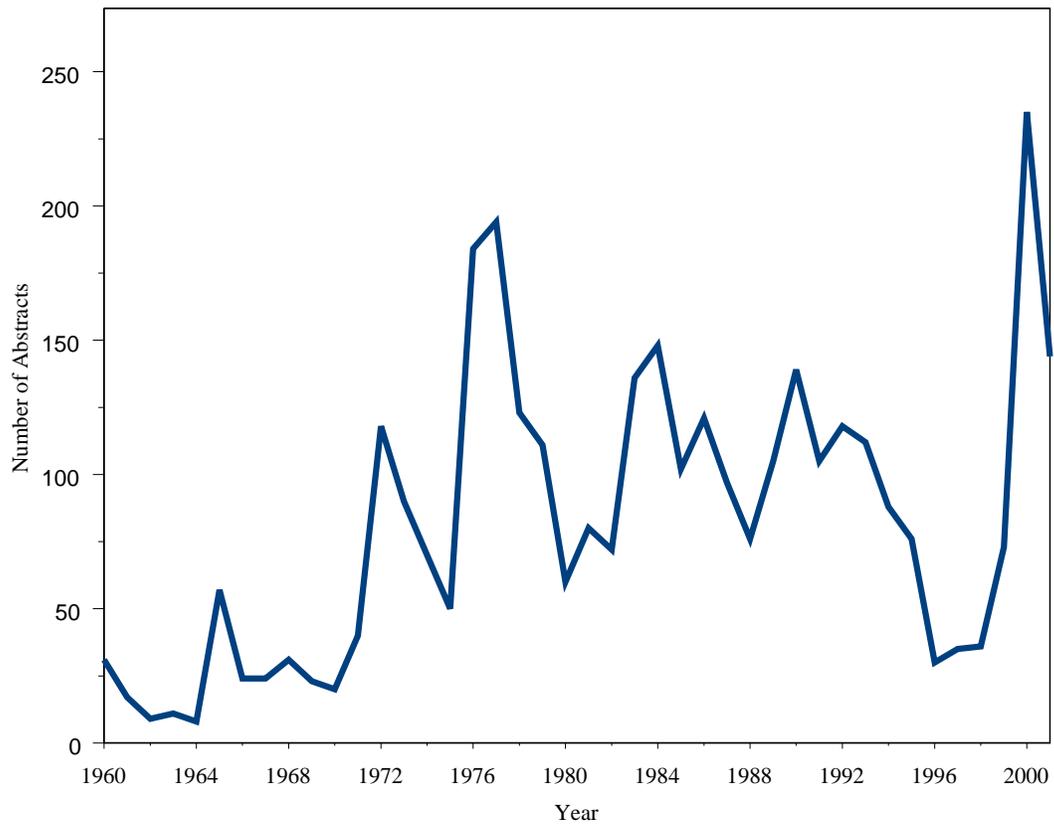


Figure 1: Attention to Death Penalty Debate Over Time

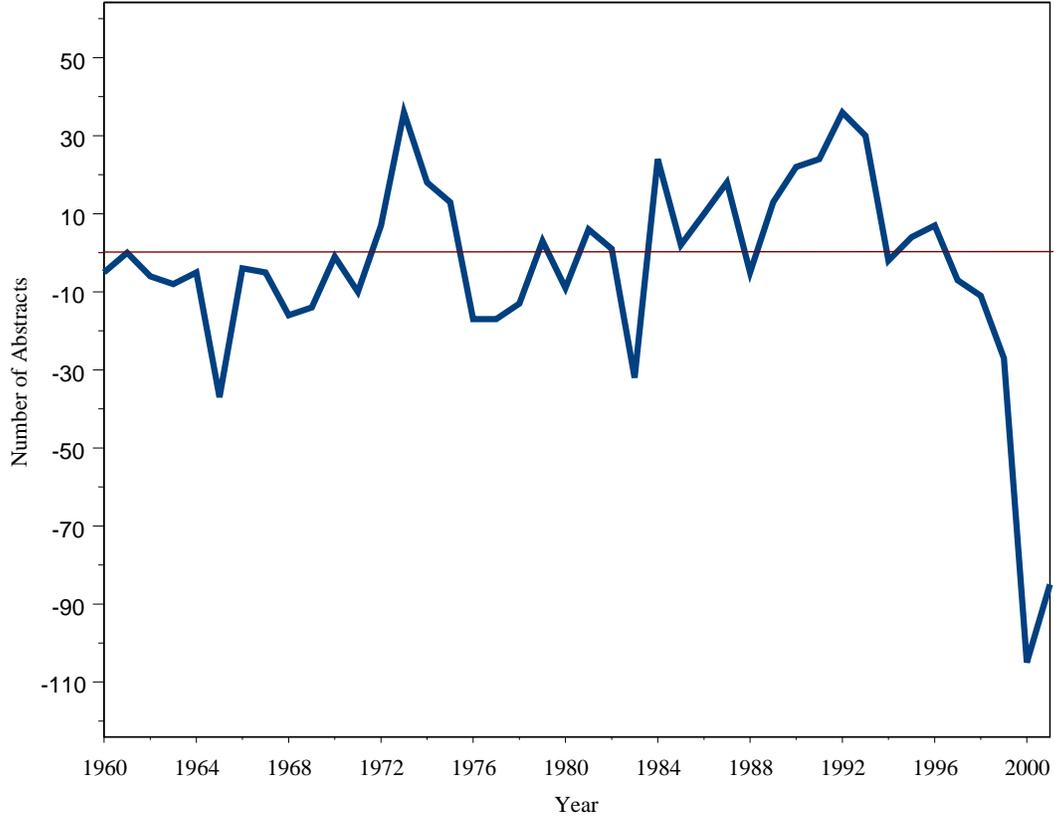


Figure 2: Net (Pro - Anti) Valenced Attention Over Time

As we have stated, previous efforts to measure issue-definition and demonstrate its development over time have focused solely on frequency counts of arguments as they fall into predefined dimensions (e.g. constitutionality, cost, etc.) based on a theoretical understanding of the issue of interest. Having defined the dimensions, these previous analyses then traced attention given to the arguments within these distinct dimensions in order to gauge which dimensions were the most salient (the most frequent), proclaiming the most prevalent dimension in a given time window to be the dominant frame by which the issue is defined in that period.

As an example of how this earlier method was used, in the case of the death penalty we can examine how the seven dimensions we defined have shifted in their saliency over time. In Figure 3, we see that while the death penalty debate was strongly driven by arguments of morality and constitutionality in the years surrounding the Supreme Court's period of moratorium (1972-1976)

and beyond, in recent years attention has shifted radically to focus on arguments within the fairness dimension.¹¹

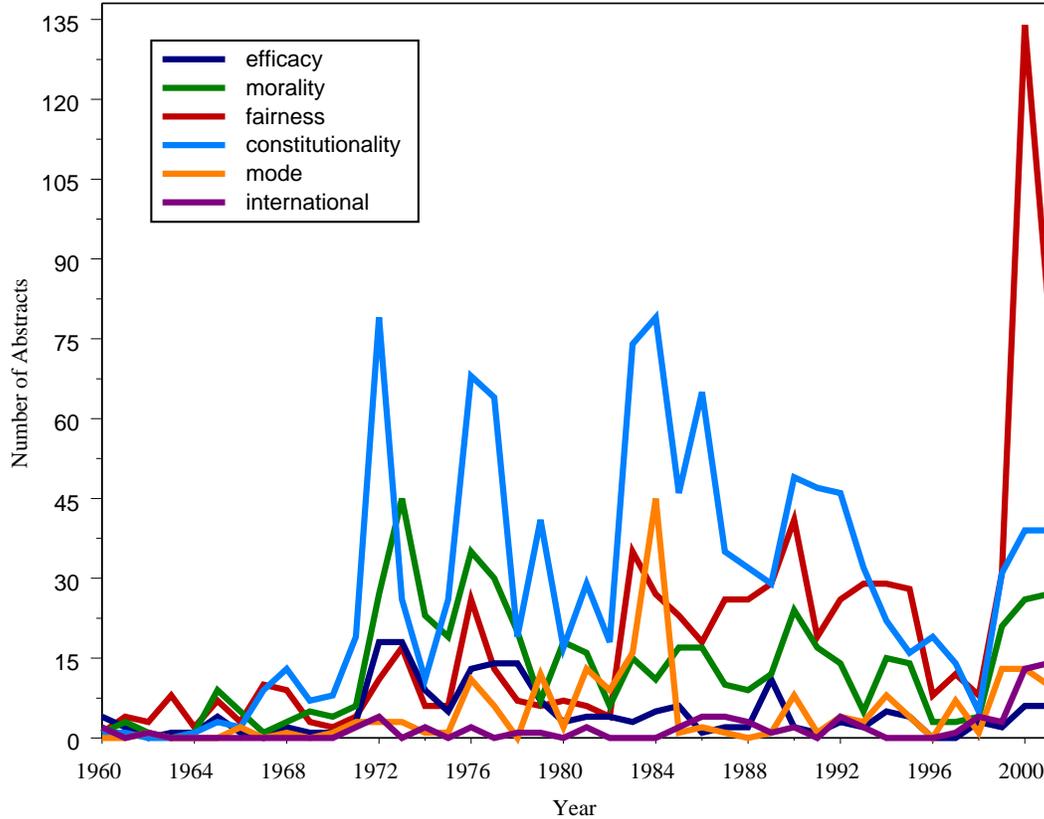


Figure 3: Attention to 7 Dimensions of Debate Over Time

Additionally, as in Figure 4, we can view how the individual arguments that comprise a single dimension shift in levels of saliency over time.¹² This view provides a more detailed story of the explosion of attention given to arguments of fairness in the late 1990s. Specifically, we see that the argument regarding the danger of convicting innocent individuals (solid line standing tallest at the right hand edge of the graph) is a prominent player in the shift in attention. Also note that

¹¹Much can also be learned about the driving force behind attention to a particular dimension by graphing the disaggregated pro- and anti-death penalty valenced sets of arguments for each dimension (e.g. pro-fairness, anti-fairness, pro-moral, anti-moral, etc. yielding 14 valenced time series in this case).

¹²Of course, we are able to graph the changing levels of attention to all 65 arguments over time, but our real goal is not only to ascertain an overall sense of how attention to individual arguments has shifted over time but also to identify patterns of attention which evolve as arguments piggy-back off one another, combining momentum.

the argument regarding the system being racist appears three times with almost equal amounts of frequency: the first two times in relative isolation (1987 and 1994) and the third time in conjunction with the late 1990s massive surge in fairness arguments.

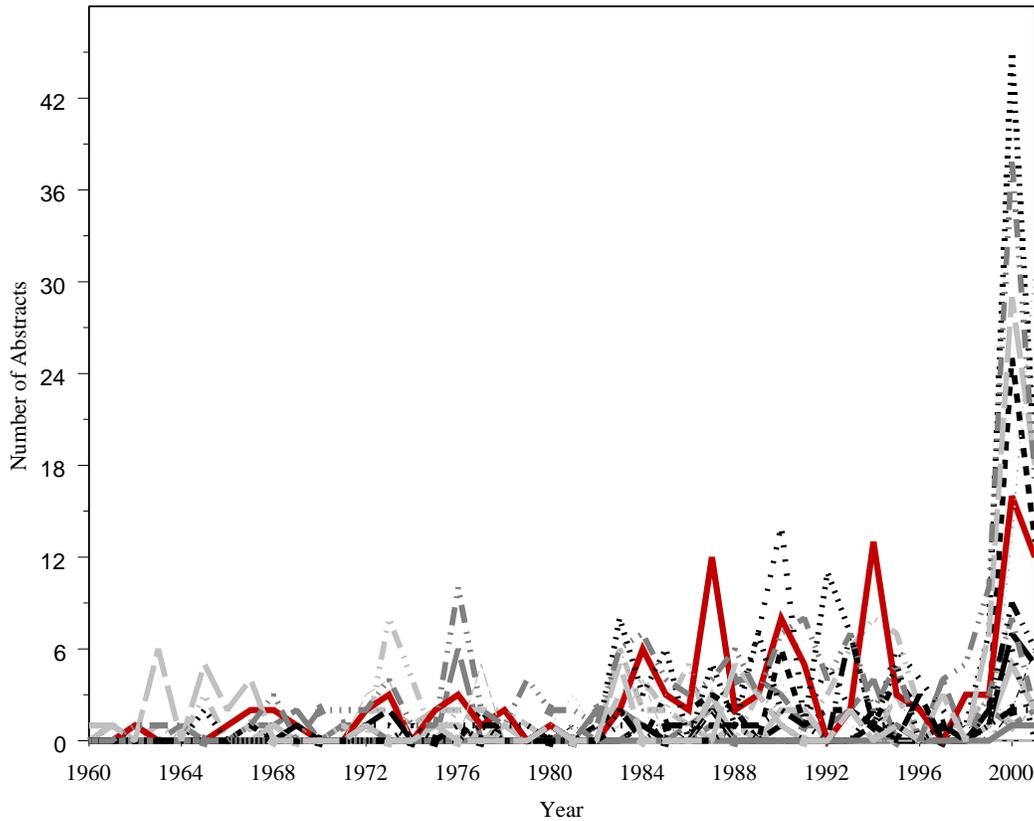


Figure 4: Attention to Fairness Arguments Over Time

These findings provide important insight into the general patterns of dialogue on the death penalty. Specifically, the 7 different times series we obtain by categorizing all 65 arguments into a theoretically predefined set of dimensions tell us much about the general story of how the issue has been framed over time. After all, in our understanding of how best to capture the mechanisms of issue framing, we put great weight on these frequency counts. What is more, we crafted the parameters of the 7 dimensions with great care. We certainly hope that graphing raw attention to these different categories gives us a general overview of how the main thrusts of the debate and how they have changed over time. As careful as we have been, however, we imposed our own (fixed)

definitions of the dimensions onto the data set. It is possible that different researchers might have selected different dimensions, producing different results. In any case, beginning with a detailed data set, we can now move on to assess the dynamic and evolutionary nature of framing in a way that is not possible with a traditional content analytic approach.

6 Applying Evolutionary Factor Analysis to the Death Penalty

The results of an evolutionary factor analysis both reinforce the overall story told by an examination of the frequency counts alone and also match more closely our understanding of the issue-definition process. Figure 5 presents the “resonance”—the summed factor loading-count products—of all the estimated evolutionary frames. (See Appendix Two for a key to the frame compositions.) The figure lists all identified frames, though we bring the readers’ attention to a small number of particularly salient and resonant frames by showing those with distinctive dashed or solid lines. Less visible or prominent frames are all presented in the same gray-scale, but each represents a distinct evolutionary frame.¹³

¹³There are many frames identified by the evolutionary factor analysis rules, however, many of these frames may be substantively quite similar.

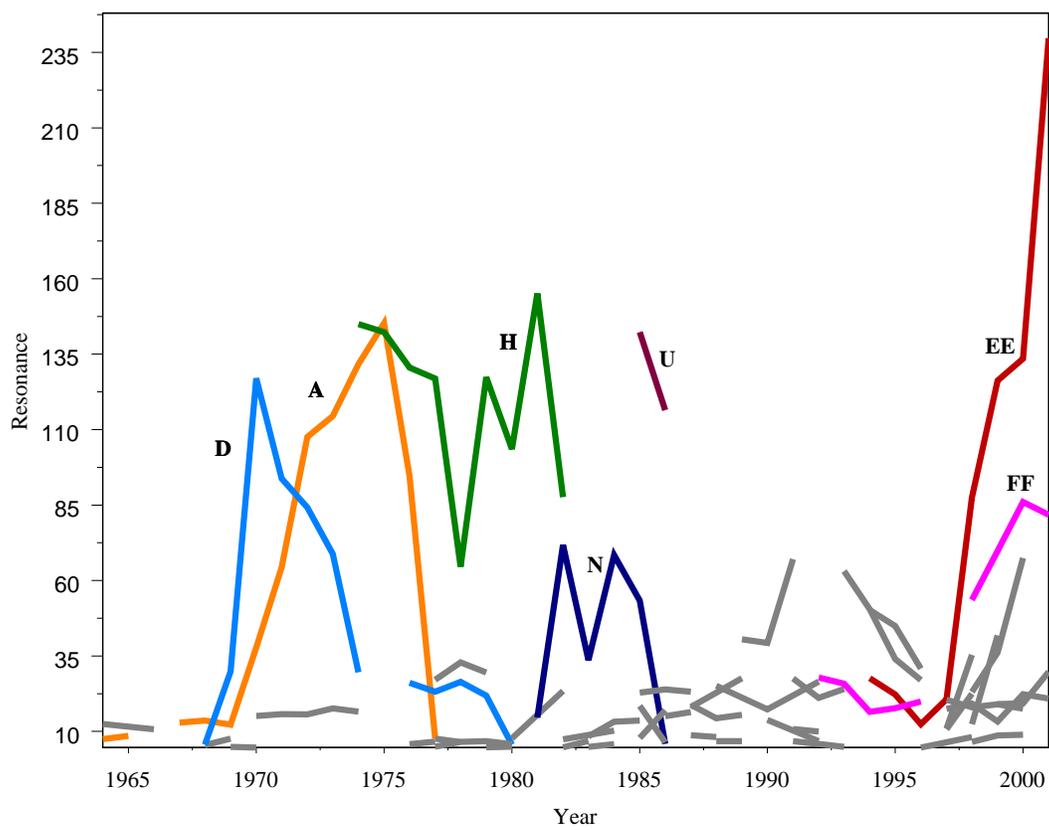


Figure 5: Evolutionary Frames

Some evolutionary frames are clearly quite strong, while the majority seem dwarfed in comparison. Yet because it takes both strong and persistent pull to be named an evolutionary frame, the myriad of grey lines across the lower portion of this chart cannot be dismissed as noise. Rather, these evolutionary frames, important in the public debate within a given time window, are muted by competing elements (such as more dominant evolutionary frames). The Figure clearly allows us to distinguish between those periods, such as the mid-1970s or the late-1990s, when a small number of frames dominated discussion, from those periods such as the late 1980s when many different frames shared attention but none dominated.

The argument compositions of all the evolutionary frames tell a story that is consistent with the overall image sketched by the frequency-count findings; in earlier periods the death penalty debate was defined primarily in terms of morality, efficacy, and constitutionality, while recent years have witnessed a redefinition primarily in terms of fairness. A closer examination of these data (not presented here) will allow the reader to note how these frames have changed over time, however. This is impossible with the traditional approach.

Each frame can be associated with either a pro- or anti-death penalty valence, since the underlying arguments are coded in such a way. Figure 6 presents the difference between the aggregated weighted pro- and anti-death penalty frames. It allows us to assess the net attention, weighted by the resonance of the various frames being used in the debate, to pro- and anti-death penalty discussion. As we can see, the results correspond in general to what might have been seen with a simpler approach. This allows us to link the dimensional focus of attention to the tone of that attention and to trace the impact of one on the other over time. The combination of these together then can be useful in allowing us to explain public policy and public opinion outcomes.

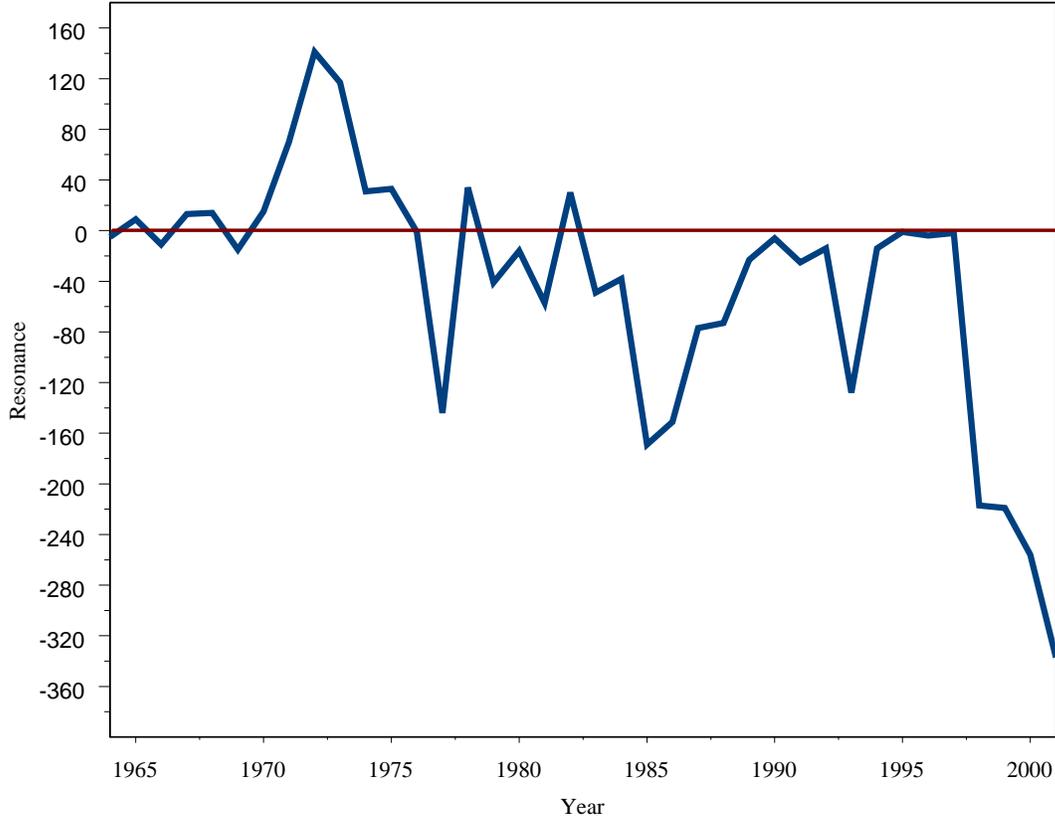


Figure 6: Net Valence of Evolutionary Frame Arguments

The fact that the results of using this new method are not radically different from those obtained through an examination of frequency counts is cause for some relief. Indeed, we know the saliency of arguments to be such an important element of the issue-definition process that we would be highly skeptical of any method that produced results inconsistent with the overall findings from the previous method. However, the differences between the results yielded by the distinct methods are both numerous and critically important.

Most evidently, the results we present with evolutionary factor analysis are not nearly as straightforward as those produced by analysis of frequency-counts alone. The absence of simplicity, however, is also a feature of issue-definition. And more importantly, when we look more closely at Figure 5, we see a more nuanced and compelling story of issue-definition on the death penalty.

We have already made the case that the method we are proposing is an improved match, both theoretically and statistically, for what we know of the mechanisms of issue-definition. The question, of course, is whether or not there are enough of the instances we discussed (instances of piggy-backing, shared momentum, etc.) and whether or not these instances are important enough to warrant the additional effort required by our proposed method. The answer, resoundingly, is yes. Although examples of the meaningful ways in which our results distinguish themselves from those obtained from frequency counts abound, we need look no farther than the example of the racism argument. This argument, when viewed from the perspective of frequency counts alone, gains prominence on three primary occasions, each with the same basic level of saliency. That is to say, previous methods of analysis have no way of distinguishing these three peaks from one another. Alternately, the method we propose accounts for the fact that the third appearance of the racism argument on the scene of the death penalty debate occurred not only against the backdrop of similar arguments, but in dynamic conjunction with these other arguments. If we are to place measurement values on the workings of issue-definition, and indeed we must do so if our goal is to gain a robust understanding of the process, then distinctions of this kind are imperative.

7 Conclusion

The evolutionary factor analysis method we propose builds on the previous method of using argument count data, but also captures essential patterns of shared variance common to particular clusters of arguments by accounting for which arguments load highly on which factors. By first allowing the data to determine which frames exist in individual time windows, then tracing the fluid composition of the more resilient of these frames (evolutionary frames) over time, and finally incorporating the saliency of the component arguments of each evolutionary frame, we arrive at an understanding of issue-definition that is both more rich and more nuanced than the view provided by previous methods. Although the demonstration we have offered of this method yields substantively important results, the true worth of the method is its portability to a wide range of issues.

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8 Appendix One: Coded Death Penalty Arguments

Efficacy

100: neutral - general
101: pro - deterrence
102: pro - incapacitation
103: pro - alternatives flawed
109: pro - other
110: anti - not a deterrent
111: anti - alternate systems better
119: anti - other

Cost

501: pro - worth it
502: pro - life imprisonment more expensive
509: pro - other
510: anti - not worth it
511: anti - death penalty more expensive
519: anti - other

Constitutional

400: neutral
401: pro - not cruel and unusual
402: pro - process upheld
403: pro - popular support up
404: pro - states rights
405: pro - federal jurisdiction
409: pro - other
410: anti - cruel and unusual
411: anti - violation of due process
412: anti - popular support down
413: anti - states rights
414: anti - federal jurisdiction
419: anti - other

Mode of Execution

600: neutral
601: pro - mode is just
609: pro - other
610: anti - mode questioned
619: anti - other

Morality

200: neutral
201: pro - retribution
202: pro - family deserves vengeance
203: pro - crime deserves death penalty
209: pro - other
210: anti - killing/vengeance wrong
211: anti - victim's family opposed
219: anti - other

International

700: neutral
709: pro - other
710: anti - complaints
711: anti - extradition problems
712: anti - foreign nationals should be exempt
719: anti - other

Fairness

300: neutral
301: pro - system is fair
302: pro - system is "too" fair; should be abbreviated
303: pro - flaws overstated
304: pro - blanket regulations wrong
309: pro - other
310: anti - inadequate representation
311: anti - arbitrary
312a: anti - racist
312b: anti - classist
312c: anti - other demographic inequity
313a: anti - vulnerable populations
313b: anti - mitigating circumstances
314: anti - mandatory sentencing wrong
315: anti - alternate punishments would be better
316: anti - evidence
317: anti - innocence
318: anti - system is broken
319: anti - other

9 Appendix Two: Evolutionary Frames and their Component Arguments

Evolutionary Frames	Component Arguments
A	101: pro efficacy - deterrence 203: pro moral - crime deserves death penalty
B	318: anti fairness - system is broken
C	319: anti fairness - other
D	100: neutral efficacy - general 111: anti efficacy - alternate systems better 210: anti moral - killing/vengeance wrong 314: anti fairness - mandatory sentencing wrong 400: neutral constitutional 401: pro constitutional - not cruel and unusual 403: pro constitutional - popular support up 409: pro constitutional - other 419: anti constitutional - other
E	312a: anti fairness - racist
F	410: anti constitutional - cruel and unusual
G	219: anti moral - other
H	200: neutral moral 210: anti moral - killing/vengeance wrong 300: neutral fairness 319: anti fairness - other 409: pro constitutional - other 419: anti constitutional - other 600: neutral mode
I	219: anti moral - other
J	209: pro moral - other
K	312a: anti fairness - racist
L	313a: anti fairness - vulnerable populations
M	610: anti mode - mode questioned
N	210: anti moral - killing/vengeance wrong 312a: anti fairness - racist 314: anti fairness - mandatory sentencing wrong 319: anti fairness - other 600: neutral mode
O	311: anti fairness - arbitrary

Evolutionary Frames	Component Arguments
P	300: neutral fairness 318: anti fairness - system is broken
Q	309: pro fairness - other
R	400: neutral constitutional
S	610: anti mode - mode questioned
T	111: anti efficacy - alternate systems better
U	419: anti constitutional - other
V	313a: anti fairness - vulnerable populations
W	317: anti fairness - innocence
X	710: anti international - international complaints
Y	319: anti fairness - other
Z	312a: anti fairness - racist
AA	203: pro moral - crime deserves death penalty 400: neutral constitutional
BB	412: anti constitutional - popular support down
CC	313a: anti fairness - vulnerable populations
DD	316: anti fairness - evidence
EE	301: pro fairness - system is fair 302: pro fairness - system is "too" fair; should be abbreviated 310: anti fairness - inadequate representation 312a: anti fairness - racist 312b: anti fairness - classist 317: anti fairness - innocence 318: anti fairness - system is broken 319: anti fairness - other 712: anti international - foreign nationals should be exempt
FF	319: anti fairness - other
GG	419: anti constitutional - other
HH	203: pro moral - crime deserves death penalty 309: pro fairness - other 600: neutral mode
II	401: pro constitutional - not cruel and unusual 403: pro constitutional - popular support up

Evolutionary Frames	Component Arguments
JJ	400: neutral constitutional
KK	300: neutral fairness
LL	219: anti moral - other
MM	412: anti constitutional - popular support down
NN	312a: anti fairness - racist
OO	313a: anti fairness - vulnerable populations
PP	318: anti fairness - system is broken
QQ	200: neutral moral 304: pro fairness - blanket regulations wrong 600: neutral mode
RR	610: anti mode - mode questioned
SS	111: anti efficacy - alternate systems better 210: anti moral - killing/vengeance wrong