Analyze and Design Compelling Arguments* using Exploratory Discourse Analysis ***DRAFT 04-10***

Introduction

The purpose of this tutorial is to give you a way to both *discover* the reasoning content of a discourse and, to *design* a compelling discourse yourself. You will need the *discovery* skill when you want to understand the reasoning inherent in even mildly complicated articles or books. You need the second skill, the *design* skills, when *you* want to convince the reader or listener of something. Fortunately, they are the same skill! Be assured, if you are fairly proficient in English, you *already* have the background skills to learn and operationalize the *discovery* and *design* skills presented here.

Discovering the Arguments Within a Discourse

For the *discover* part, I have in mind to help you logically analyze, via diagrams, the *argument content* of open ended questions, the kind you get from freewheeling surveys or interviews, as well as the arguments as found in *any* body of text. This process will help you detect coherence of arguments, as well as potential holes in reasoning, yours as well as the authors!

Designing Your Own Arguments

For the *design* part, I will draw on your *discovery* skills to present your own arguments, organized in a persuasive manner. Keep in mind that when you write a thesis or almost any other document, you are usually going to be making a case for explaining, justifying, or advocating some position/conclusion or other. The question is - can you convince your reader or listener of the merits of your presented argument? This tutorial goes some way in describing that design skill set. The idea is to explicitly lay out (in your own initial draft materials at least) your arguments and conclusions, in a diagram format. Looking at your proposed organization, you can then more easily decide how to present these arguments in the most compelling way for your envisioned audience.

The Perspective Adopted

For this tutorial I have mainly adopted the perspective advanced by Stephen N. Thomas in his book *Practical Reasoning Using Natural Language*. Thomas is in the long tradition of logicians, such as C.S. Pierce (*Existential Graphs*), Monroe Beardsley (*Thinking Straight*), and Alec Fisher (*The Logic of Real Arguments*), who were aware of the acute limitations of formal logic, and have chosen instead to extend their analyses *of* natural language by using the tools and techniques *of* natural language. I continue that tradition by incorporating Pierce's and Thomas' insights, with applications focused specifically on the argument agendas as found in *university level work.*

> As an aside, readers of this web site may recognize a common theme here: semi-graphical analyses supplemented with textual descriptions. It's no accident that I have named this approach EDA (Exploratory *Discourse* Analysis) since it is a companion to Exploratory *Data* Analysis. The Discourse theme continues with a text diagramming/analysis technique that applies very generally to natural

> English. The word *discourse* covers any coherent body of text, from a sentence up to volumes of material.

Since I have done a little work in Fuzzy Logic, I long ago realized that there was no situation where black and white were ultimately distinguishable. We use sharp edged, black versus white statements only as *approximations* to the much more subtle gradations relating them This obviously hold true in the real world where a statement and its opposite invariably have something in common. That commonality is a result of our human evolution and awareness of the context in which all discussion occurs. So, what you will learn in this tutorial is that the tools of logic help to construct a diagram, a picture, which you can then *modify* based on *your* unique experiences, perceptions, and prejudices!

Cut to the Chase

Let me start off slowly by showing you a single sentence taken from the quote shown in the extract below. That single sentence conforms to the definition of a discourse. This then, will be your first foray into exploratory discourse analysis. The extract is a passage from Chapter 20 of Mary Shelly's Frankenstein: (Dr. Frankenstein has created a manlike creature but now is confronted by its malevolence - actually brought about by his (Frankenstein's) own actions). The (surprisingly eloquent) eight foot monster speaks:

> I may die; but first you, my tyrant and tormentor, shall curse the sun that gazes on your misery. Beware; for I am fearless, and therefore powerful. I will watch with the wiliness of a snake, that I may sting with its venom. Man, you shall repent of the injuries you inflict."

I am going to extract one sentence from this passage and analyze it, as Example 0.

Example 0: Frankenstein's Creation Speaks

"Beware, for I am fearless, and therefore powerful".

The idea is to identify and then quantify, the reasons and conclusions found in this discourse, with a view to deciding on the strength (value) of those conclusions. Take a moment and see what you think are the reasons and conclusions embedded in this discourse. You may want to check on the list of key words that indicate that what follows is either a reason or a conclusion. "Inference Indicators - What Follows is a Reason or Conclusion" on page 7.

I have diagrammed this sentence below, exposing its linked chain of argument structure. I am sure you could have done this in your head but, sometimes when there are several dozen linked/interrelated arguments, it's helpful to keep it all straight with some kind of drawing, augmented with descriptive/explanatory text. What is interesting here is that the conclusion *Beware*, is stated first, even before the reasons are developed. This illustrates the non-mechanical (that is, informal) role that you and I take on when evaluating natural language discourse, and more specifically, argument structure within a discourse.

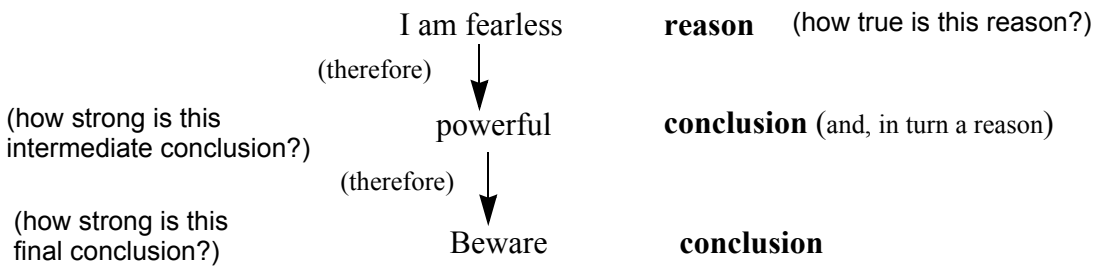

FIGURE 1. Frankenstein's Monster Speaks

That was Mary Shelly's monster speaking (actually, the creator of the monster was Dr. Frankenstein but, over time, the monster has taken on its' creator's name). That single sentence contains *reasoning*, a chain of inferences as shown. The arrows are intended to convey the flow of the argument from reasons to conclusion, or as Thomas puts it, the flow of *belief* from reason to conclusion. My additional comments, within parentheses, are intended to further clarify this argument flow. The analysis goes like this:

From the reason *for I am fearless*, the author concludes [I am] *therefore powerful*. Following on, the author then uses that conclusion, [I am] *powerful,* as a reason to conclude *Beware,* even though *Beware* comes first. (See template 7 "Deductively Valid Reasoning Templates under Aristotelian Logic" on page 18).

Your role as a reader or listener of such an argument comes in a series of steps:

- Identify the reasons and conclusions, using any inference indicators (perhaps even requiring a restructuring of the text for clarity, supplying elided inference indicators or even some careful re-writing). In this case there are reason inference indicators, *for* is one of those. There is a conclusion indicator as well, *therefore*. Actually, that first intermediate conclusion [I am] *powerful*, is used as a reason for the final conclusion, [you should] *Beware*.
- To what extent do I believe the *reasons* to be true? (your knowledge and experience inserted here). Suppose that the reason given, *for I am fearless* is true, based on your personal experience with monsters, or maybe you think it is only partially true? Similarly, [I am] *powerful* is an (intermediate) conclusion that you may or may not agree with and perhaps, only partially, in any event.
- Given that the reasons are *true* though, how strongly is the *connection* between them and the conclusion supported? Determining the strength of that connection, between reasons given and conclusion drawn, is the second task you are confronted with. The diagramming tools presented here can to help but, ultimately, this becomes a personal decision, that is, your judgement faculties must be inserted here!
  This is where the strength of an argument comes in. If you don't think the argument is absolute, how strong do you think it is? See "Strength of Arguments - Gradations of Belief" on page 8.

So, determining the truth of the reasons as well as conclusions given is usually an empirical task and depends on your knowledge and experience. It may require *uncertainty* investigations such as: additional information gathering (simulations, statistical analyses?), policy or ethos analysis, or re-

lationships and liaison determinations. (My students may recognize *uncertainty* investigations and *ethos* analyses from lectures on *Planning Under Pressure* as well as *MOISE* tutorials).

The follow-on task is to determine the strength of the reason-conclusion connection, that is the test of strength of *validity*. Notice that reasons could be true as well as the conclusion but the text doesn't show a connection. For example, "I am human therefore planets orbit the sun". (Actually, I was having a hard time writing any argument chain that wasn't connected at some tenuous level of strength)!

My intent is to give you the tools to analyze a whole article as easily as this single sentence. In fact you can consider this whole tutorial as a *discourse,* a discourse on exploratory natural reasoning.

Relation to Formal Logic

[note that the following paragraph is one long argument!]

There is no attempt here to try to translate English text into some other more formal language such as predicate logic or its extensions, work through mechanical procedures, and then translate back to English. That task is irrelevant to the uses of logic envisioned here since, even in principle, it is *not possible* to do such translations beyond toy examples. Therefore, we will start with English, use your knowledge and judgements about English for the analysis, and end up with English (and a touch of math) to express your conclusions. I will call on your knowledge of the nuances and subtlety of English (notice that those subtleties are not translatable to formal languages anyway) to structure the raw text under consideration into a form you can then evaluate.

The plan is to describe a procedure that will allow you to semi-graphically analyze any discourse, as far as its *arguments* go. This way of looking at text lets you combine and diagram *justifications*, *proofs*, *advocacy*, as well as *explanations*. Once you have detected the argument structures of your discourse or media, you can assess the strength of those identified arguments. That is, you can assign a numeric measure as to how good each argument appears to be.

Argument, in this tutorial, is a word simply meaning that the discourse under consideration contains implicitly or explicitly, reasons and conclusions. Note that both reasons and conclusions may be implicit (if you can find them), but must be there in order to qualify as an argument. So, using this procedure you can diagram out the structure of your question responses or your reference material so as to show how one conclusion follows (or doesn't follow) from the reasons given. From your analysis, you can then assess the strength of the conclusions in a manner you can then map into numbers. From these numbers you can then perform further analyses using other techniques such as statistics or decision analysis tools like the Analytic Hierarchy Process (AHP).

I think you will find that you are constantly analyzing 'arguments' in your daily routine, whether from listening to your companions, the news media, or other sources, to see what conclusion you agree with, which ones you don't, and the majority that lie somewhere along a continuum.

[Rob's soap box] I would submit that *all* consequential natural language arguments have gradations of strength/validity, with none absolutely true.

An Expanded Exploratory Discourse Analysis

Let me now expand on the natural reasoning approach wielded by Frankenstein's monster, to show how to start extracting reasoning from raw text or verbal discussions. Note that the example argument below is one where the reasons for the conclusion are not entirely convincing, which is typical, but instead, the reasons provide *some* support for the conclusion(s). This example illustrates the common situation where the argument has less than absolute strength and therefore shows what

is called *partial* validity. This idea of partial validity is a crucial stance to take when analyzing these natural language text modules. Drawing out the argument helps to start the dialog with self and others as to the strength of conclusions that can be drawn.

Example 1: The Hapless Contractor

Suppose you read or heard the following discourse sentence, what would *you* conclude?

Since it took 2 years for the contractor to finish the school annex, and additionally, the bricks shortly began to chip and discolor, and the plumbing leaked, it's clear that the contractor was incompetent or dishonest.

Suggested Procedure for your analysis:

First determine if the discourse contains reasoning. In this case, it does, as we can see the use of key words and phrases that introduce reasons and conclusions (check out the tables of inference key words in Table 1. below). You can go a couple of ways at this point - if you know something about the particulars of the text, you could add in your arguments as *external input.* I have done that below by adding in my knowledge that this particular contractor has a 'sterling' reputation. You could also add in your reasons for or against the *reasons* of the author as well as your reasons for or against the author's *conclusions*. Two different tasks.

Otherwise you can go on only what is given (like in a jury trial, you are only allowed to consider evidence explicitly presented).

To clearly set out the argument found in the discourse, I would break it down into a set of declarative sentences as follows:

1. It took 2 years to complete the annex - (a reason to support the conclusion since it shouldn't take that long!)
2. The bricks (shortly) began to chip and discolor - (a reason to support the conclusion)
3. The plumbing (shortly) leaked - (a reason to support the conclusion)
4. The contractor is incompetent or dishonest - (the conclusion)

At this point I have extracted the reasons and the conclusion(s) from the text and can now diagram these sentences and their connections, and so begin to assess validity (strength of conclusions). I now ask myself:

1. To what extent are the reasons true? If they are false then I can't conclude anything. This is where the empirical work comes in such as fact checking, interviews, opinions, and specific domain knowledge.Was 2 years too long if the school district budget only allowed phased work? Did the bricks actually discolor or was that an effect of lighting or poor vision or ignorance of the original color? Plumbing leaks are a little easier to detect but again, maybe the leak was the result of a maintenance back-hoe severing a pipeline rather than defective piping? In a lot of cases, you only know what is given in the document and it will take some digging to get the whole story.
   In this case, I am going to assume that the reasons given are all I know, except for my knowledge about the contractor's general reputation.
2. The conclusion is supposed to follow from the reasons but in reality there is always a *back story*, that is, additional context that would be helpful to be aware of. Perhaps this contractor has multiple complaints in the better business bureau files, which might prejudice your judgments against her.
   Suppose though, I know this contractor and she is of sterling character and is by no means incompetent!. I don't believe she would do shoddy work although I haven't actually examined the bricks or the plumbing at this particular site.
3. To add a touch of reality I have gone ahead and added in that external additional reason, based on knowledge outside of the text given to me, namely that I personally know that the contractor in questions has a 'sterling' reputation. How does that fit in?

What can I say about the argument now? Let me diagram this out so I can get a better look at the flow. I place the reasons/justifications/explanations above and use solid line arrows to point down

to the conclusion. In this case, the arguments are intended to '*And'* together independently. That is, each one can stand alone and could have been asserted independently. For example, I could have just presented one of these reasons as a justification for the conclusion, but of course, I need to follow what I assume is the argument the author intended.

If I am going to augment the author's argument, l would want to bring in all the reasons I could, often from multiple perspectives. For example, if I know the contractor has a 'sterling' reputation, I can bring that into argument as another reason. In this instance though, it is a reason *against* the conclusion, indicated by a dashed arrow. Notice that I have also included a tag called [external] *to show that this is an external addition, not found in the text under analysis*. Later we will see that knowing this background is crucial for a determination of the validity of advanced arguments.

Finally, even when the reasons are true, I wouldn't conclude 100% that the contractor was incompetent or dishonest. In fact, you can see that one reason actually acts against the conclusion and would be taken to mean that the conclusion was weakened. It is this explicit, visible, diagrammatic, determination of strength of judgement that is the take-home advantage of this type of reasoning.

A major figure in the development of natural reasoning, as I mentioned earlier, is Steven N. Thomas whose basic approach I have adopted. Thomas' book, *Practical Reasoning in Natural Language,* has a valuable suggestion on how to go about an argument's validity determination. Thomas says to ask yourself what he calls the *Magic Question*:

> "Supposing the reason(s) were true, is there any way in which the conclusion nevertheless could be false". If there exists no imaginable or conceivable way in which the conclusion could be false if the reason(s) were true, then the given step of reasoning is "deductively valid".

If however, there is a way for the conclusion to be false even when the reasons are true, then you know the argument is not 'iron clad' (that is, not deductively valid) and you then need to make a judgment along the "strength of argument line". That line is shown in the section "Strength of Arguments - Gradations of Belief" on page 8, and gives you a choice of range of strength of argument from: absolute, very strong, strong, moderate, weak, none, with all gradations in between. If you are following other tutorials on this web site, you will see that I have tried to match up these gradations with those of the *Analytic Hierarchy Process* since that technique also relies on comparison judgments.

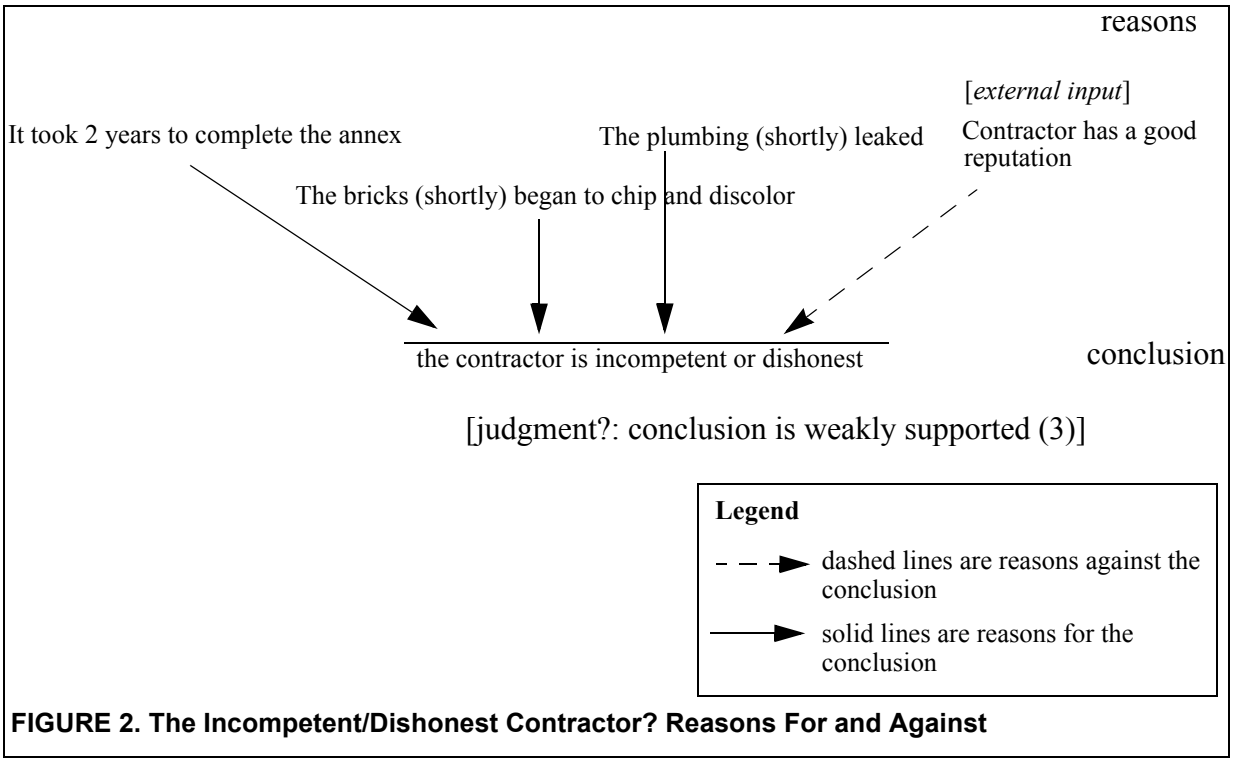

FIGURE 2. The Incompetent/Dishonest Contractor? Reasons For and Against

Inference Indicators - What Follows is a Reason or Conclusion

Below are some words that appear in text that often indicate that reasoning is present. Of course, some of these words are used for other purposes in a sentence. The ellipsis shows where the reason or conclusion might follow. Be careful of words like as, since, for - they are used in lots of other contexts. (Again, this shows how our grasp of the human context defeats the mechanical translation of syntax indicators).

TABLE 1. Reasons & Conclusions (adapted and extended from Thomas)

Inference Indicators Of Reasons, Premises	Inference Indicators Of Reasons, Premises	Conclusion Indicators Of Results, Outcomes	Conclusion Indicators Of Results, Outcomes
as . . .	assuming that . . .	therefore . . .	leads to . . .
since . . .	can be derived from . . .	in conclusion. . . .	suggests that . . .
for . . .	can be deduced from . . .	just goes to show you that . . .	demonstrates that . . .
because . . .	additionally . . .	demonstrates that . . .	therefore . . .
as indicated by . . .	moreover . . .	proves that . . .	clearly . . .(a favorite of math professors)
as shown by . . .	additionally . . .	indicates that . . .	we see that . .
Inference Indicators Of Reasons, Premises	**Inference Indicators Of Reasons, Premises**	**Conclusion Indicators Of Results, Outcomes**	**Conclusion Indicators Of Results, Outcomes**

TABLE 1. Reasons & Conclusions (adapted and extended from Thomas)

Inference Indicators Of Reasons, Premises	Inference Indicators Of Reasons, Premises	Conclusion Indicators Of Results, Outcomes	Conclusion Indicators Of Results, Outcomes
follows from . . .	consider that . . .	implies . . .	its obvious that . . . (another favorite of math teachers!)
being that . . .		it follows that . . .	looks like . . .
in so far as . . .		then . . .	
firstly, secondarily, . .		so . . .	
seeing that . . .		thus . . .	
in view of . . .		entails . . .	
whereas . . .		accordingly . . .	

Inference Indicators Of Reasons, Premises	Inference Indicators Of Reasons, Premises	Conclusion Indicators Of Results, Outcomes	Conclusion Indicators Of Results, Outcomes

Strength of Arguments - Gradations of Belief

Here is a scale that can be used to assess the strength of an argument: Use numbers in between for finer judgments. I have deliberately used the same scale as Thomas Saaty's AHP. His scale is concerned with judging the relative importance/strength of one result/outcome over another, *within a given context*. Here, in EDA, the strength of judgement is made by the reader's implicit understanding of the context in which the argument is made.

1	3	5	7	9
Neutral/None	Weak	Strong	Very Strong	Absolute
no connection of reasons to conclusion	some connection	strong connection	very strong	deductively valid

Student-on-the-way-to Colleague Discourses

What follows are a few excerpts from student-colleague papers with analysis of their reasoning. These are raw excerpts with no attempt to 'clean them up'. I will just go through them, rearranging a bit, and pointing out what reasons I can find. I haven't made an attempt to judge the strength of the conclusions drawn, leaving that for a classroom discussion. (Note that these papers were written *before* any discussion of exploratory reasoning analysis).Note: all of these are reproduced with the permission of the authors.

Mental Health Care

[Jerry Boehm 2008, Chandler Az.]

"A graduate student at Northern Illinois University walks into a geology class auditorium and begins shooting students, killing five and wounding many more. Another student at the University of

West Virginia opens fire on his fellow students, killing thirty and wounding fifteen. (U.S. News/ MSN) From Columbine High School in Colorado to the University of Arizona; from workplaces, shopping malls and churches across the United States, the incidents of people opening fire on gathered crowds has reached and epidemic level and is growing rapidly. What do most of these tragic events have in common? The person doing the killing had a known psychiatric illness or had recently experienced a psychiatric event that was known to family and friends. What is also becoming very apparent is that this country does not adequately provide for the mental health care needs of our citizens."

Analysis: first break up the discourse into declarative sentences

1. A graduate student at Northern Illinois University walks into a geology class auditorium and begins shooting students, killing five and wounding many more.
2. Another student at the University of West Virginia opens fire on his fellow students, killing thirty and wounding fifteen. (U.S. News/MSN)
3. From Columbine High School in Colorado to the University of Arizona; from workplaces, shopping malls and churches across the United States, the incidents of people opening fire on gathered crowds has reached and epidemic level and is growing rapidly.
4. What do most of these tragic events have in common?
5. The person doing the killing had a known psychiatric illness or had recently experienced a psychiatric event that was known to family and friends.
6. What is also becoming very apparent is that this country does not adequately provide for the mental health care needs of our citizens

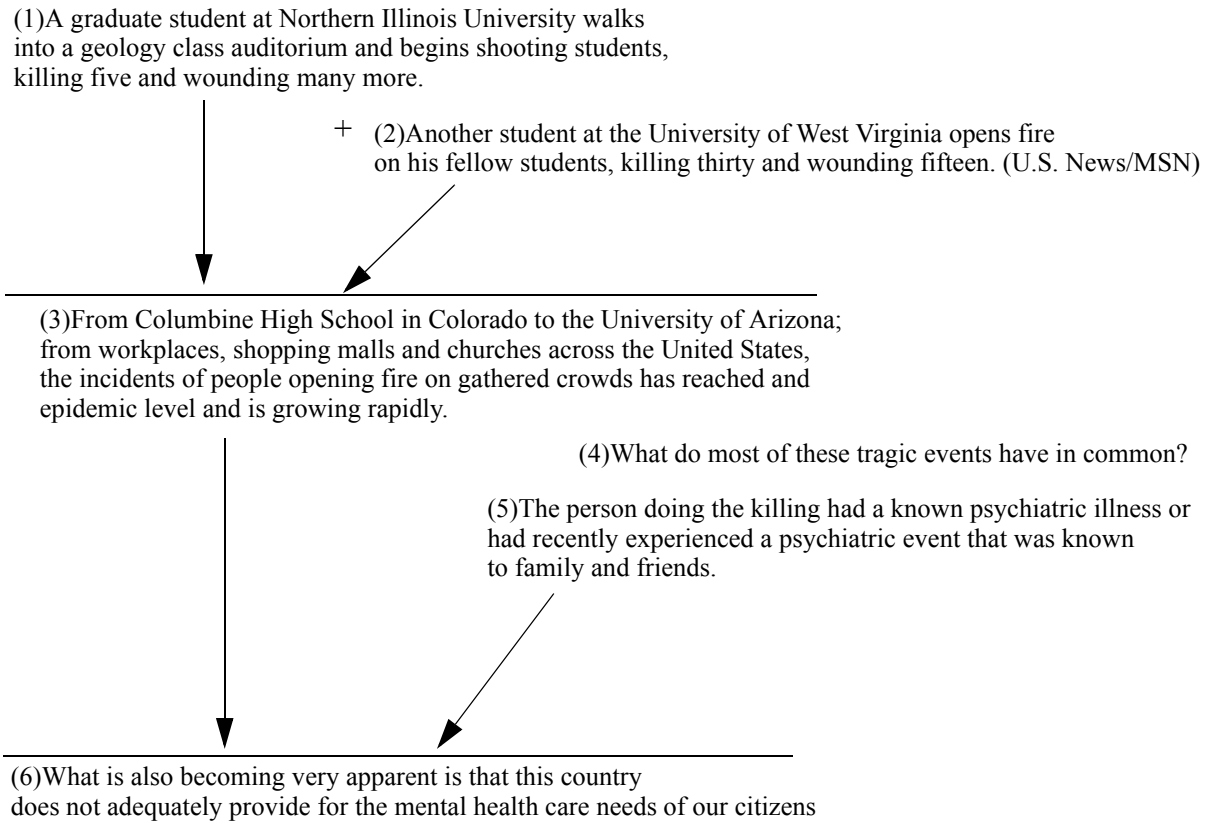

FIGURE 3. Mental Health Needs

Water Management in the Southwest

[Thomas Gaskill 2008, Phoenix Az.]

"Three factors have conspired to place Arizona at an especially important turning point in its water resource management history. First, the Active Management Areas are about to embark on the Fourth Management Plan and must achieve groundwater recharge balance by 2025. Second, the Colorado River Drought Management Plan was concluded in late 2007. Finally, the pressure for resolution of the enormous water claims by, especially, the Navajo Nation and the San Carlos Apache Tribe is reaching a crisis point. There is an urgent need to identify, implement and coordinate best practices in water resource management."

1. (1)Three factors have conspired to place Arizona at an especially important turning point in its water resource management history.
2. (2)First, the Active Management Areas are about to embark on the Fourth Management Plan and must achieve groundwater recharge balance by 2025.
3. (3)Second, the Colorado River Drought Management Plan was concluded in late 2007.
4. (4)Finally, the pressure for resolution of the enormous water claims by, especially, the Navajo Nation and the San Carlos Apache Tribe is reaching a crisis point.

5. (5)There is an urgent need to identify, implement and coordinate best practices in water resource management.

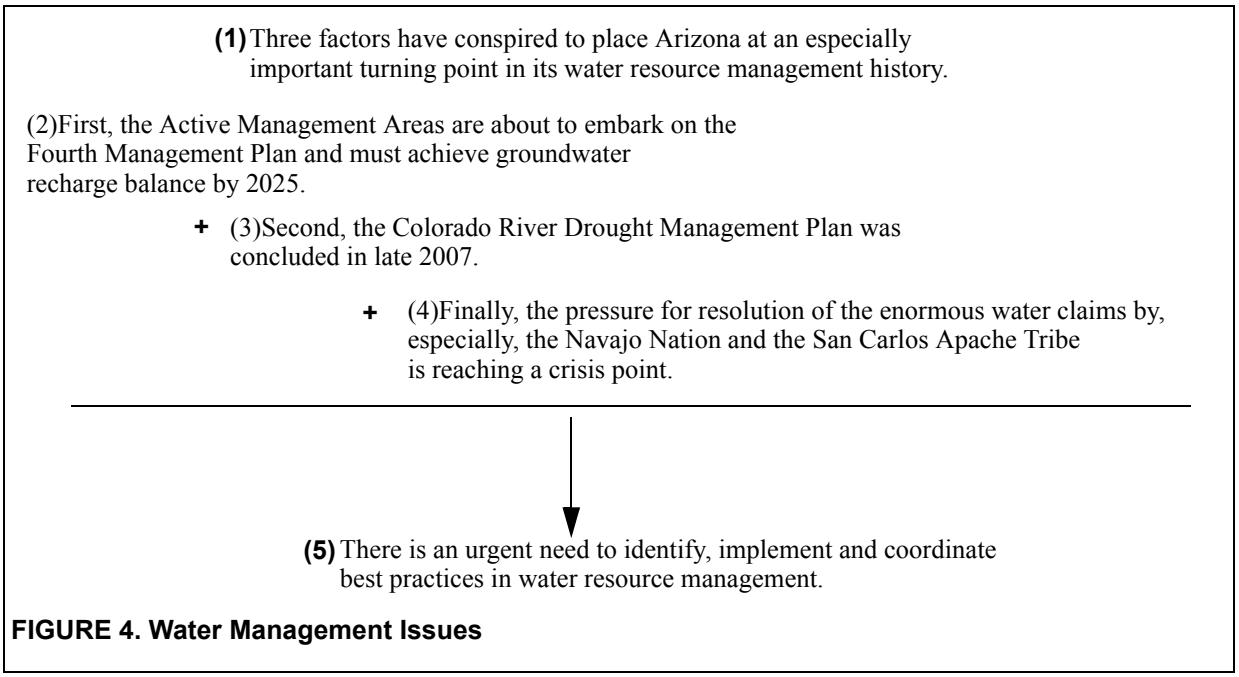

FIGURE 4. Water Management Issues

Open Spaces for Phoenix Arizona

[Terry Mcavoy 2008, Phoenix Az.]

"As our cities and suburban areas around the United States continue to grow, the importance of open space lands in our communities' grows as well. Arizona is one of the fastest growing places in the United States. According to the Arizona Department of Commerce between 1990 and 2000 Arizona grew by 40%. Between 2000 and July 2004, it is estimated that Arizona added an additional 700,000 new residents. The population of Arizona is projected to reach over 11 million people by 2050.

New residents require new places to live and work, so homes, schools, offices, retail centers and roads are needed and will continue to be built to accommodate Arizona's growing populace. The Valley (the urban/suburban area around Phoenix, AZ) adds over 60,000 new residents per year, requiring over 20,000 new housing units. (Steiner, Mc Sherry, Brennan & Soden, 1999) As Arizona's urban areas continue to expand, they need new land to build on. Development companies may work with the State Land Department via public land auction, or private citizens who may have large land holdings in areas that not too long ago were considered too far from the urban core. Now this land is desirable and needed to be developed to keep up with the demand for new homes and businesses. One component of the development puzzle that is sometimes overlooked or given the lowest priority is the inclusion of open space areas."

Analysis:

1. (1)As our cities and suburban areas around the United States continue to grow, the importance of open space lands in our communities' grows as well.

2. (2)Arizona is one of the fastest growing places in the United States. According to the Arizona Department of Commerce between 1990 and 2000 Arizona grew by 40%. Between 2000 and July 2004, it is estimated that Arizona added an additional 700,000 new residents. The population of Arizona is projected to reach over 11 million people by 2050.
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6. (6)As Arizona's urban areas continue to expand, they need new land to build on.
7. (7)Development companies may work with the State Land Department via public land auction, or private citizens who may have large land holdings in areas that not too long ago were considered too far from the urban core.
8. (8)Now this land is desirable and needed to be developed to keep up with the demand for new homes and businesses.
9. (9)One component of the development puzzle that is sometimes overlooked or given the lowest priority is the inclusion of open space areas.

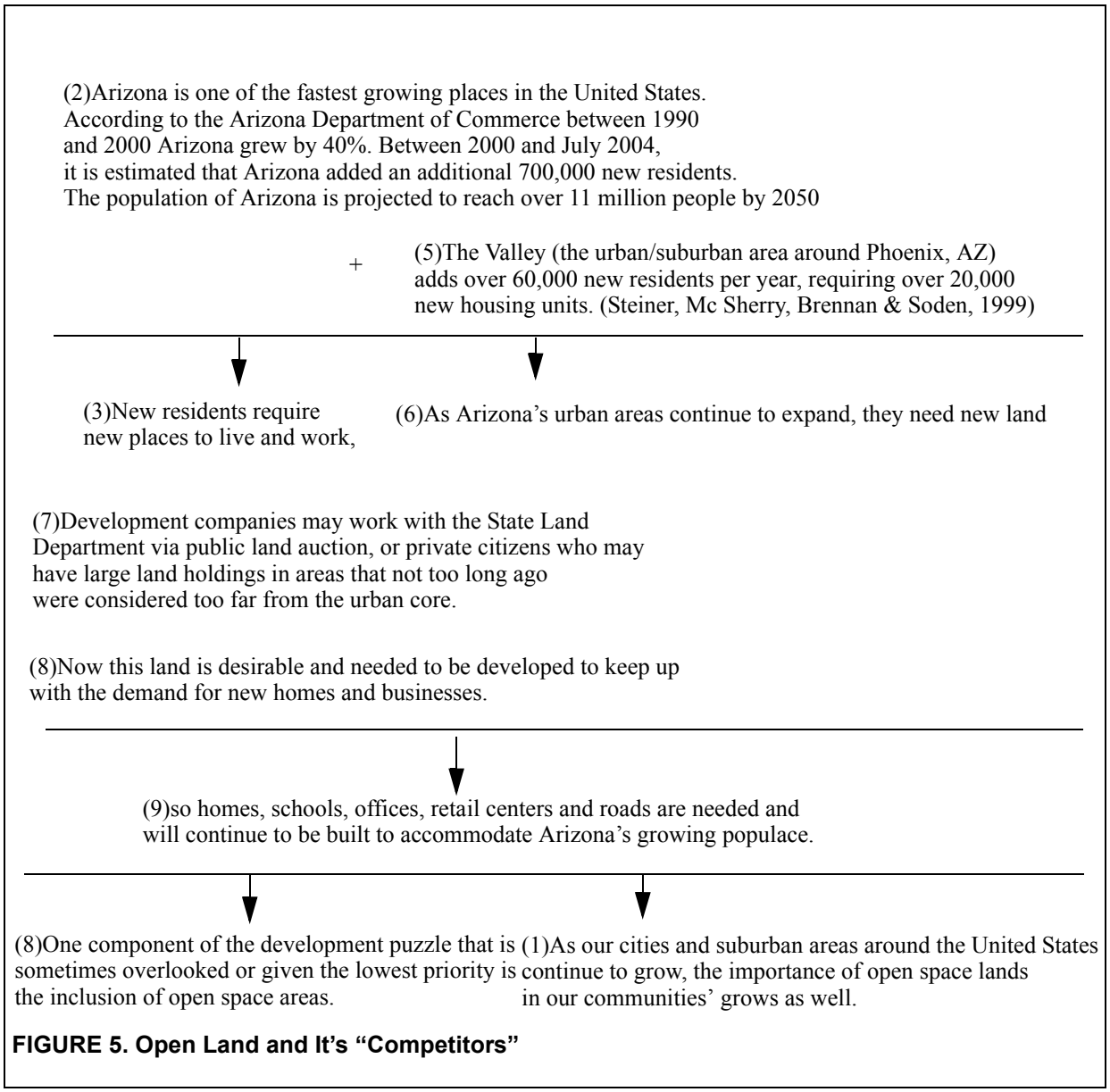

FIGURE 5. Open Land and It's "Competitors"

The Value of a Financial Instrument to the Individual Investor

[Ed Green, Chandler Az.]

"Every day in the marketplace, more and more attention is given to the ups and downs of exchange traded funds (ETFs). They are becoming more prevalent in financial news reports and currently track almost every known index. A prodigious amount of ETFs are currently on the market available to investors with more being issued with great regularity. It is becoming increasingly possible for investors to track some very specialized indexes and sectors.

ETFs have been in existence since approximately 1993 in the U.S., but are only just beginning to be noticed by smaller individual investors. Many more sophisticated investors have already been using ETFs as opposed to individual stocks and mutual funds as a way of indexing at a very low cost. This strategy has allowed non-institutional investors to utilize strategies only available to professional managers. With ETFs, individuals can better strategize their portfolios on an

individual basis. Portfolios can now be constructed using sectors, industries, global assets, and hard assets such as gold. The individual investor can diversify away unsystematic risk in a cost efficient manner by using the ETFs and getting a whole sector instead of just a few companies. By weighting particular sectors according to their own philosophy instead of relying on predetermined indexes and fund managers discretions for trading within those sectors, investors are able to create a more personalized portfolio".

1. (1)Every day in the marketplace, more and more attention is given to the ups and downs of exchange traded funds (ETFs). They are becoming more prevalent in financial news reports and currently track almost every known index. A prodigious amount of ETFs are currently on the market available to investors with more being issued with great regularity.
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7. (7)The individual investor can diversify away unsystematic risk in a cost efficient manner by using the ETFs and getting a whole sector instead of just a few companies.
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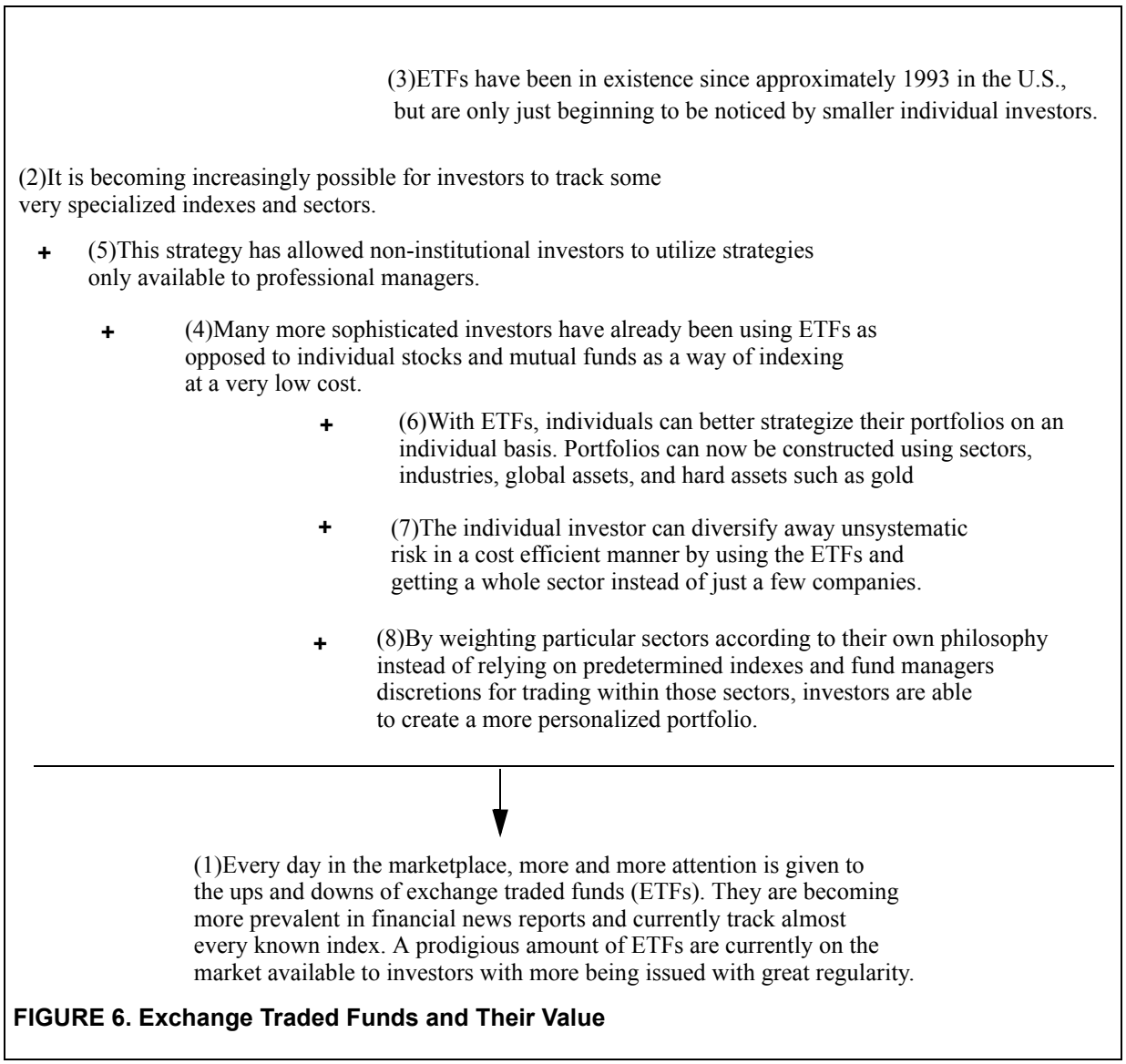


FIGURE 6. Exchange Traded Funds and Their Value

Advancing the Cause of Women

Here the author is concerned to discover the factors preventing or inhibiting the advancement of women to executive positions in technology firms. [Aishwarya Adyanthaya 2008]. What I have extracted here would need to be augmented with an assertion of the antecedent to make the conclusion valid. Right now, I have shown only a conditional statement whose truth or falsity would need to be established.

"If the technology-oriented corporations make concerted efforts to address the issues highlighted in this study, it will lead to an increase in the number of women employees outside of the traditional administrative roles which in turn will lead to an increase in the number of women leaders."

*This illustrates a different argument structure, namely a conditional argument (see the section "Conditional Sentences" on page 16).

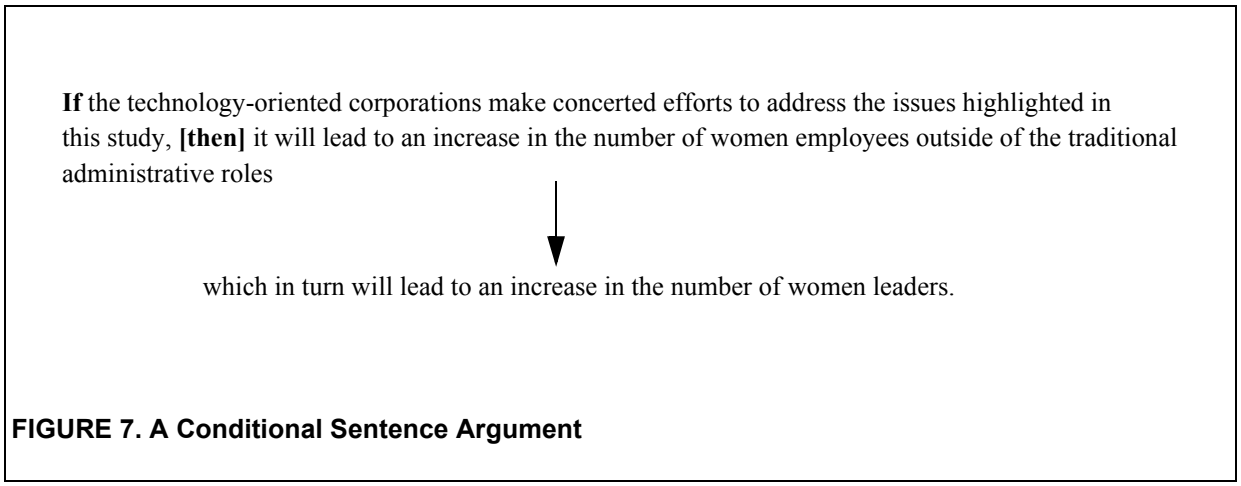


FIGURE 7. A Conditional Sentence Argument

Conditional Sentences

As you have seen from the excerpt, "Advancing the Cause of Women" on page 15, conditional sentences routinely appear as part of arguments in trying to 'make a point' or to convince ourselves or others. So, a brief digression about conditional sentences is warranted.

A conditional sentence comes as one package, but is internally separable into two parts. One part is called the *antecedent* (ante= before), and the other part the *consequent*. What this package sentence asserts is that in case the antecedent is true, or comes to pass or will come to pass, then the consequent will happen or come to pass. There are true conditionals and there are false conditionals, with all gradations in between.

Conditional Sentence Examples

There are conditionals that are True and conditionals that are False. A conditional is True if whenever the antecedent is True, the consequent *must* be True as well.

The Defining Question:

If there is some way that the antecedent can be true and yet the consequent be False, the entire conditional is False.

The first two conditionals below are decidable just on an internal logical basis, while the second two depend on interpretation by the reader.

1. if a real number is less than 10 then it is less than 20 (a True conditional)
2. if a real number is less than 10 then it is less than 5 (a False conditional)
3. if the U.S. builds a missile system in Poland, Russia will retaliate economically (True?, partly true?, your choice)
4. The smell of fresh baked bread usually evokes pleasant memories (True?, partly true, your choice) - (Note that this statement could be written as:
   if someone smells fresh bread, then that person will usually experience pleasant associative memories).

Further Notes on Conditionals

As a shorthand notation, a conditional statement is often written as:

if P then Q.

P --> Q

Here 'P' stands for the antecedent clause while 'Q' stands for the consequent clause. This is all one

package, "if P then Q". It is the package as a whole that can be True, False, or in between (it can't be in-between in *Aristotelian* logic however) .

For example: "Red sky in the morning, sailors take warning."

I have re-written this as a conditional (I have placed parentheses around the clauses):

if (the sky is red in the morning) then (sailors should take warning).

If you can determine that the antecedent being true, guarantees the consequent being true, then you have a *true* conditional. In the above statement, the antecedent being true doesn't guarantee trouble for sailors but, long experience does suggest that there is a connection between a red sky in the morning and bad weather to follow. So, as usual, the conditional statement has some strength that you could assess and assign a grade to. Consider the conditional statements below: (the second one incidentally, is true, while the first one depends on the topic, no matter how hard I study!)

- *If I study real hard, I will master the material*
- *Black clothing in the Kahalari desert is cooler than white clothing (If you wear black clothing in the Kahalari desert, then you will be cooler than if you wear white)*

Necessary and Sufficient Conditions

You can use conditional statements to express both necessary or sufficient conditions (as well as both!). Let me use the standard notation where P and Q are statements, being either True or False.

Necessary Conditions Expressed by a Conditional

A necessary condition means that the consequent expresses something that the antecedent requires. Maybe not everything that the antecedent requires, but at least one required condition.

If there is a fire, then oxygen is present.

Here, a fire burning means that necessarily, oxygen is present. Notice that oxygen is not enough for a fire, but it is a *required/necessary* factor. This can be written as: P-->Q where P= "there is a fire" and Q= "oxygen is present".

*An alternative and common way to say this is: *There is a fire only if oxygen is present.*

P only if Q

Notice the "only if" connector. Its' role is to specify the necessary condition.

Sufficient Conditions Expressed by a Conditional

A sufficient condition holds when the antecedent is enough to guarantee the occurrence of the consequent.

If I add enough heat to this water under the proper conditions, then it will boil.

If I own an Isuzu pickup then I own a truck.

The sufficient condition here for boiling is that enough heat is added under the proper conditions, and, I do own an Isuzu pickup, which guarantees that I own a truck.

P="I own an Isuzu pickup", Q="I own a truck"

P --> Q

Necessary and Sufficient Conditions Expressed by a Special Conditional Syntax

Occasionally, you will find that the consequent is necessary for the antecedent and also, the antecedent is sufficient for the consequent. This effectively says both P-->Q and Q-->P are true. This

is usually written with a double arrow as: P <-->Q

another common notation is to say: P iff Q where the "iff" stands for if and only if.

Deductively Valid (Aristotelian) Reasoning Templates

Below is a table of useful reasoning templates. These structures have been developed over time and shown to most often lead to correct reasoning rather than incorrect reasoning. You will recognize some of them from other studies and general knowledge. Keep in mind that these are the Aristotelian templates where black and white, True and False, are considered distinguishable!

TABLE 2. Deductively Valid Reasoning Templates under Aristotelian Logic

Template **P and Q are statements having truth values of either True or False***	**Discussion/ Interpretation**
(1)P being True means that Not P is False while P being False means that Not P is True	the negation of a True statement is False, the negation of a False statement is True. You can also say: "it is not the case that . . . " for example: it is not the case that P is True means that P is False (Note that a statement and its negation are never both True) ***This is Aristotelian logic and doesn't hold in the real world where every statement has shades of truth, shades of gray.
(2) Not Not P -> P	a double negation restores the original truth value.
(3) P -> Q	This is a conditional statement, think of it as a whole 'package', and the whole package itself may be either True or False. It can be written in alternative ways as below: if P-> then Q, P only if Q, Q is necessary for P, P is sufficient for Q Not P or Q *** this is an important equivalence that is often used
(4) [P -> Q] - >[Not Q -> Not P]	"Transposition" the first conditional you can think of as expressing the necessity of Q in order for P to happen. So, it follows that if Q is necessary for P to happen, then no Q means no P.
(5) [P and P->Q] -> Q	"Modus Ponens" (affirming the antecedent). Remember that P ->Q is a conditional statement. Starting with just P->Q you can't conclude Q. But, if you can *also* guarantee that the antecedent 'P' occurs, then the combination *does* guarantee Q
(6) [Not Q and P->Q] -> Not P	"Modus Tollens" (denying the consequent). From (4) you have [not Q -> not P], combining this with (5) you get [not Q and not Q-> not P] -> not P
(7) [if P -> Q And Q -> R] ->[P -> R]	"Pure Hypothetical Syllogism". This is the underlying template for linked reasoning. See the 'Frankenstein' argument for an example
(8)[(P or Q) And Not P] -> Q	"Disjunctive Syllogism" This is a conditional statement that can be either true or false. If I claim that the conditional is true however, then the following must occur: Remember, for a conditional to be true, if the antecedent is true then the consequent can't be false. This just says that if the statement [P or Q]is True, one or the other or both must be True, but, if P was actually False, then Q must have been the True one.

Template **P and Q are statements having truth values of either True or False***	**Discussion/ Interpretation**

TABLE 2. Deductively Valid Reasoning Templates under Aristotelian Logic

Template P and Q are statements having truth values of either True or False*	Discussion/ Interpretation
P <--> Q	P is a necessary and sufficient condition for Q, and Q is a necessary and sufficient condition for P. You could think of this as two 'if' statements, joined by 'And' : (P->Q) And (Q->P) P iff Q is another way to write this, where 'iff' == if and only if
Suppose, for the sake of argument that	Suppositional Argumentation **********
***This is be the next phase in this tutorial, where I talk about conditionalization, or suppositional arguments	In this kind of argument the author advances an argument that she may or may not believe, but just suppose that ..... For example: suppose, just for the sake of argument that: *If robots are developed by the military, they will benefit civilian companies.*

Template P and Q are statements having truth values of either True or False*	Discussion/ Interpretation

Truth Trees (Semantic Tableau)

For more complex reasoning structures you can learn to describe their interactions using what are called *truth trees*. You will still need all your *discovery* skills as far as identifying the components of the argument, but the complexity may overwhelm you. Truth trees were developed in the 1930's by the mathematician Gerhard Gentzen to analyze what are called propositional statements. To test the validity of a set of reasons leading to a conclusion, you check to see if *there is any way that the reasons being true could still allow a false conclusion*. (This is Thomas' magic question again). Note that the truth tree method is again 'brittle' from my perspective since it leads to a yes/no outcome, either the argument is deductively valid or it isn't.. That is not realistic, so I re-interpret the method to lead to gradations of strength of the argument.

The overall intent is to look for contradictions among a set of statements. A contradiction happens when all statements can't be true at once, and so the argument is NOT deductively valid.

Procedure: **** need to express what the sentences mean when added to the tree, assume true?? dont think so *** so how say this???

1. Break up the discourse into short (as possible) declarative sentences.(use the Truth Table Logical Equivalences)
2. *Negate the conclusion*. (this will suppose, just for the argument procedures, that the negation is true)
3. Start the 'tree' by writing down one sentence. The idea is to suppose that each sentence is 'true'
4. Pick another sentence, supposing it were true, and adjoin it onto the initial sentence. Note that if this is an 'Or' sentence then the tree branches. If it is an 'And' sentence then the tree 'stacks'. If this is a conditional statement then the tree branches.
5. Keep adding sentences, assuming them to be true, to the tree, looking for contradictions that will close off a branch.A contradiction will occur when a statement and its negation appear in the same branch.
6. If you have added all sentences to the tree, either all branches are closed off, or there is one or more still 'open'.
7. If all the branches are closed off then there is no way that all of the sentences could have been true (this set includes the negated conclusion remember) and so the argument is VALID.
8. If there is one or more branches that are open, then those branches are an example of the set of sentences being all true, under some condition. Since this branch must have included the negation of the conclusion, then here is a case where a False conclusion can be consistent with True reasons. The argument is then INVALID.

For example, here is a set of sentences I made up that contains reasoning, but it would be a little tough to figure out if the conclusion was supported, and, if so, to what extent. I made up the tiny

story to illustrate how we, as humans, tend to describe situations. There is no way a formal language like *Predicate Logic*, could capture all the judgements that go into analyzing the story below. Lets see though, what structural help can be offered by using some of the reasoning templates shown in "Deductively Valid Reasoning Templates under Aristotelian Logic" on page 18.

Profiling, the American Way

"Seems to me that Paul is either American or Irish. If Paul is Irish, then he would like Guiness or Singing. I know Paul doesn't like to sing, I've heard him and he's terrible! If Paul is an American though, he would like football and trucks. I hear Paul likes trucks *and* football. After thinking about this, I'm betting a Guiness that Paul is American".

Is this a 'good' bet?

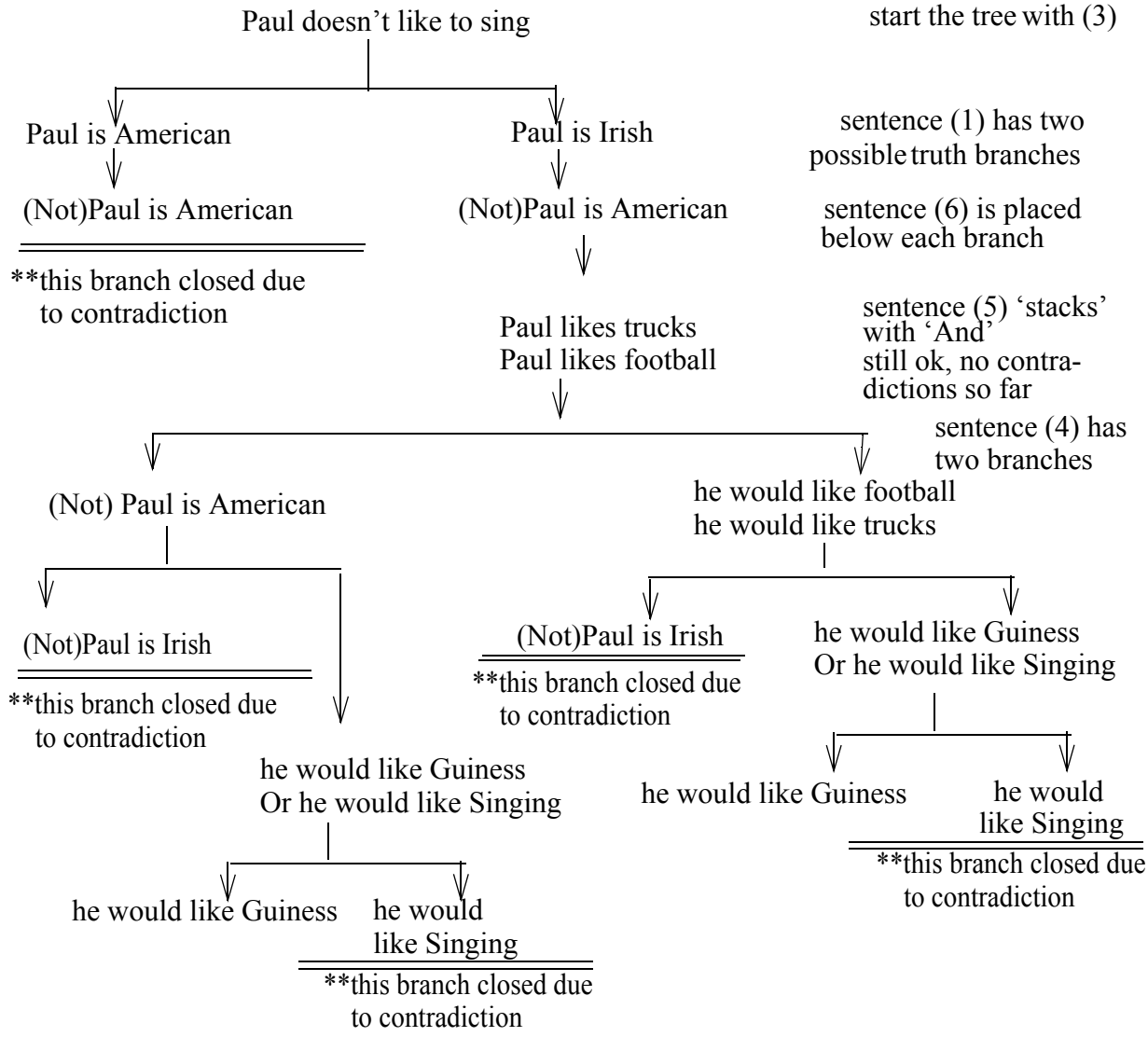
Ok, the plan is to see if there is some way that all the reasons could be true and the conclusion (*Paul is American*) be false. That would signal an invalid argument and so would not be a good bet. On the other hand, If there is no way the reasons could be true and yet the conclusion false, then the argument is valid and the bet would net me a Guiness! (a really good thing!)

An equivalent way to say this is that: is there SOME way that all of the statements, reasons plus the NEGATION of the conclusion, all be true? If that happened, then you would have found a contradiction, and the argument would be INVALID. Remember, for valid reasoning, it must be the case that there is no way the reasons could be true as well as the negation of the conclusion being true as well. If I can find one or more ways that could happen then I would have a contradiction. O.k, below are the initial sentences. I'll start a tree using equivalent structures from "Deductively Valid Reasoning Templates under Aristotelian Logic" on page 18. For example if a statement has an 'Or' in it, I can break it up into two branches, reflecting the two ways that the sentence could be true. That is, P Or Q would lead to two branches in the tree. Sentence (1) below is like that. Another interesting sentence that breaks up into two branches is our old friend the conditional. It turns out that P --> Q is equivalent in truth value to (Not)P Or Q, sentence (4) is like that. Just for grins, below is the Truth Table that shows these logical equivalences that I used in the truth trees. (Note that these equivalences are also shown in Table 2, but without all the possible Truth values). That is, when I encountered a sentence in the discourse joined with an "Or" I started two new branches. When I encountered a conditional sentence in the text I started two new branches, using the (Not)P Or Q equivalence.

TABLE 3. Truth Table Logical Equivalences

P	Q	P Or Q	P And Q	(Not)P Or Q	P --> Q
T	T	T	T	T	T
T	F	T	F	F	F
F	T	T	F	T	T
F	F	F	F	T	T
P	**Q**				

(1) Paul is either American or Irish.
(2) If Paul is Irish then he would like Guiness or Singing
(3) Paul doesn't like to sing
(4) If Paul is an American he would like football and trucks
(5) Paul likes trucks and football
(6) (Not)Paul is American



** Uh Oh --- here are two paths through the tree that didn't turn up any contradictions. This means that the argument is INVALID. This also means that the truth of the reasons don't guarantee the truth of the conclusion. This follows since I was able to show a way that the reasons could all be true and yet the conclusion could be false. (I actually showed that the negation of the conclusion could be true, along with the reasons, which is an equivalent formulation).

FIGURE 8. A Truth Tree analysis of an invalid argument.

Summary

I have presented some ideas and tools for analyzing and constructing discourse arguments that are intended to explain, justify, or advocate for some position or other. The tools for the analyses and construction consist of diagrams that organize natural english clauses into chains of reasoning for the purpose of determining the strength of the arguments. Along the way I have shown some reasoning templates that work under rather restrictive circumstances but are a start. Truth trees are introduced and a couple of examples may pique your curiosity to go and learn more about them.

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