Sun Tzu and the Rules of Victorious Warriors
Analysing the rules of Sun Tzu using Mind maps

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Abstract

In this paper we examine an ancient Chinese work on strategy and warfare: Sun Tzu, "The Art of War", from the perspectives of logic, mathematics, and computer science. Making use of contemporary mind mapping methods, we show how logic can be extracted from this 2500 year old text.

A hierarchical decomposition of the text, as constructed using mind maps, allows us to highlight patterns and structures in the text. We will look at:

Pairs of Opposites. A pair of opposites is not an enumeration with two elements. It is used to explain how seemingly opposite or contrary forces may actually be complementary, for example: direct and indirect (chapter 5), empty and solid (chapter 6).

Enumerations, to clarify reasoning, such as: Thus we may know that there are five essentials for victory (chapter 1). In addition to explicit enumerations, there is mention of numbered things, such as five colors (chapter 5), without saying what they are.

Conditionals, such as: If victory is long in coming, then men's weapons will grow dull and their ardor will be damped (chapter 2).

Preference order, as illustrated by the following detail (chapter 3):

- It is better to take a country intact, than to destroy a country;

- It is better to capture an army intact, than to destroy an army;

- ...

- It is better to capture a squad, than to kill a squad;

Implications (故 gu, therefore), with a discussion about its difference in meaning between ancient and modern Chinese.

Our work is based on the translation of Lionel Giles, made in 1910, and on comparisons with the original Chinese text. We found that mind maps enable us to bring back some of the rhythm and visual structure of this book which are obscured in many translations, because the translators tried to produce a readable narrative.

1   Introduction

In this study we are looking at Sun Tzu, "the Art of War", An ancient Chinese work on strategy and warfare. [1]

At the third conference on the History of Logic in China in Tianjin, April 2014, one of our colleagues who is involved in the project of the Handbook of the history of logic in China, said to us that he considers Sun Tzu, the Art of War, to be a logic text. It is not the type of logic text we are familiar with today.

Compared to the other six classics from Chinese Strategic theory [5], the text of Sun Tzu differs by being far more structured and by the occurrence of patterns like enumerations and chains of arguments.

This famous book, which is very popular in business circles today, was written about 500 BC. Scientists or translators studying "the Art of War" are in general looking from the perspective of history, military science, philosophy, or linguistics. The background of the authors of this study is quite different: mathematics, computer science, and logic. We think that this new perspective provides new insights, particularly about the logic used by Sun Tzu.

The use of mind maps adds a visual dimension to the text and can therefore provide a substantially new insight as shown by the results: finding logical structures in Sun Tzu's work that we have not seen before in such a systematic way.

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[1] This paper describes work in progress that has been presented at the conference **The Making of the Humanities VII**, University of Amsterdam, November 15-17, 2018. Full details can be found on the website: http://suntzu.squaringthecircles.com/. In addition to the description of the patterns as presented in this paper, the site shows mind maps for all chapters, English and Chinese text. For the first 6 chapters you can see the modifications we made to the translation. This paper is a follow-up of the work on the logical and game theoretical aspects of the text of Sun Tzu and ancient Chinese strategic theory in general, prepared for the forthcoming handbook of the history of logic in China [28].

Why is the visual dimension important? Consider the well know saying that "a picture is worth a thousand words". Think also of the problem of solving a Sudoku puzzle. Try to imagine solving a Sudoku in your head, without the visual representation of a square divided into 81 little squares in front of you!

"The Art of War" contains 13 chapters, where the first 6 chapters are considered more theoretical and the last 7 chapters are more practical. In our work, we look primarily at the first 6 chapters.

"The Art of War" was translated into English by Lionel Giles in 1910. Although there are many, and better, translations made later, this is still the most used translation because it has no copyright. You can find the text here: http://www.gutenberg.org/ebooks/132, or the text without commentary can be found here: http://www.gutenberg.org/ebooks/17405 .

1.1 Famous Quotes

Here is a short list of famous quotes that many people know about, even if they never heard of Sun Tzu and his book "The art of War":

- It is said that if you know your enemies and know yourself, you will not be imperiled in a hundred battles.

- When we are able to attack, we must seem unable.

- Victorious warriors win first and then go to war, while defeated warriors go to war first and then seek to win.

- It is best to win without fighting.

Maybe you noticed that these quotes all concern war and fighting. However, in Sun Tzu's book there is other content that would be worth mentioning in any list of quotes. For example, this poetic text:
There are not more than five musical notes, yet the combinations of these five give rise to more melodies than can ever be heard.
There are not more than five primary colors, yet in combination they produce more hues than can ever been seen.
There are not more than five cardinal tastes, yet combinations of them yield more flavors than can ever be tasted.
Our interpretation of this text is that there are always unlimited possibilities even with limited means.

To explain how we found this quote, we start from the quote, put it into a mind map form, figure 1, then we look at the complete mind map of

chapter 5, figure 2, were we found this quote, to arrive finally at the original text.

Then we go back to the details to explain how the mind map are made. This is detailed in the section about the use of mind maps. In this section we show a few mind maps that are intuitively understood, we hope.
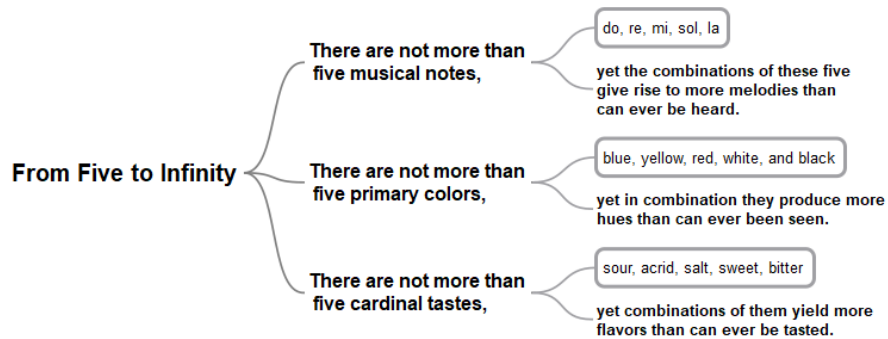

Figure 1: The annotated quote rendered as mind map.

In the translation of L. Giles, the five ingredients for infinite possibilities are given. In the original Chinese text, these are omitted, maybe because every Chinese person is supposed to know the five ingredients for each category.

Next we look at how this mind map fits into the larger mind map of chapter 5:

The yellow colored part shows our from five to infinity text. If we look for that part in the original text, we see that it does not stand out:

If you look back to our larger mind map, figure 3, and relate that to the original text, you see that all text is still there, but that structure is added, which makes it easier to see what this chapter contins and is trying to tell us. In the section about how to create the mind maps you will see our method of making them.

2   Mind Maps and Patterns

The text of Sun Tzu's book is very structured. In the Chinese text this is more visible than in the English translations that we studied. With the help
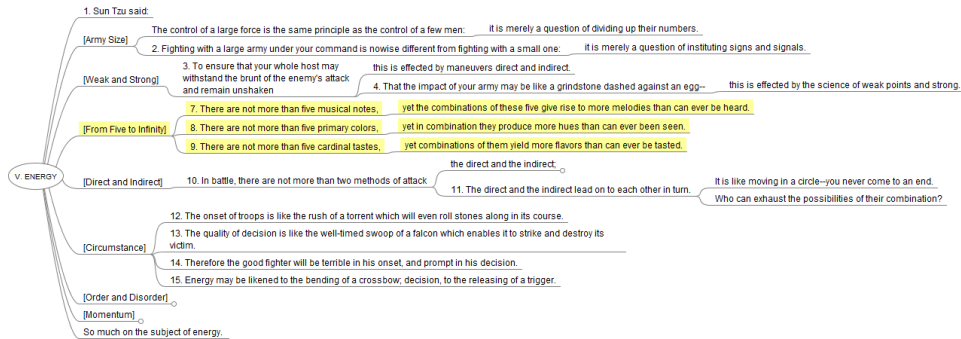
Figure 2: The mind map of chapter 5. Some of the structures are collapsed to get a better overview.

of mind maps we try to highlight this structure again and find the reasoning that Sun Tzu used.

A mind map is a way to visualize information in an organizational and hierarchical structure. An example is given in figure 4. Visual methods to help brainstorming, problem solving, structuring of a subject and so on is quite old, and in IT-circles several charting methods have been in use. In business circles graphical brainstorming methods are made popular again by Tony Buzan in the 1970-ies.
See for a more detailed description of mind mapping:
https://en.wikipedia.org/wiki/Mind_map.

When it became possible to show graphics on computer screens, a multitude of tools to create mind maps were developed, such as *Freemind*, which we used to develop our mind maps.

Freemind, as the name suggests, is a free, open source tool to create mind maps. We like the very simple representation it allows, without colors, bells and whistles, which makes it possible to show the structure of the text.

Feemind did not allow to import directly the semi-structured text we created from the "Art of War" in the Gutenberg edition of the translation by L. Giles. We used a tool named iThoughts that allowed this import and had an export facility into Freemind format: https://www.toketaware.com/.

The tool that allows us to show the mind maps in an interactive way on the web, My Mind: https://github.com/ondras/my-mind is fine on a PC, but not on a tablet, therefore you will find in addition to the interactive maps, also the expanded mind maps as images, both in English and Chinese, one mind map per chapter.

V. ENERGY

1. Sun Tzu said: The control of a large force is the same principle as the control of a few men: it is merely a question of dividing up their numbers.

2. Fighting with a large army under your command is nowise different from fighting with a small one: it is merely a question of instituting signs and signals.

3. To ensure that your whole host may withstand the brunt of the enemy's attack and remain unshaken-- this is effected by maneuvers direct and indirect.

4. That the impact of your army may be like a grindstone dashed against an egg--this is effected by the science of weak points and strong.

5. In all fighting, the direct method may be used for joining battle, but indirect methods will be needed in order to secure victory.

6. Indirect tactics, efficiently applied, are inexhaustible as Heaven and Earth, unending as the flow of rivers and streams; like the sun and moon, they end but to begin anew; like the four seasons, they pass away to return once more.

7. There are not more than five musical notes, yet the combinations of these five give rise to more melodies than can ever be heard.

8. There are not more than five primary colors (blue, yellow, red, white, and black), yet in combination they produce more hues than can ever been seen.

9. There are not more than five cardinal tastes (sour, acrid, salt, sweet, bitter), yet combinations of them yield more flavors than can ever be tasted.

10. In battle, there are not more than two methods of attack--the direct and the indirect; yet these two in combination give rise to an endless series of maneuvers.

11. The direct and the indirect lead on to each other in turn. It is like moving in a circle--you never come to an end. Who can exhaust the possibilities of their combination?

12. The onset of troops is like the rush of a torrent which will even roll stones along in its course.

13. The quality of decision is like the well-timed swoop of a falcon which enables it to strike and destroy its victim.

14. Therefore the good fighter will be terrible in his onset, and prompt in his decision.

15. Energy may be likened to the bending of a crossbow; decision, to the releasing of a trigger.

16. Amid the turmoil and tumult of battle, there may be seeming disorder and yet no real disorder at all; amid confusion and chaos, your array may be without head or tail, yet it will be proof against defeat.

17. Simulated disorder postulates perfect discipline, simulated fear postulates courage; simulated weakness postulates strength.

18. Hiding order beneath the cloak of disorder is simply a question of subdivision; concealing courage under a show of timidity presupposes a fund of latent energy; masking strength with weakness is to be effected by tactical dispositions.

19. Thus one who is skillful at keeping the enemy on the move maintains deceitful appearances, according to which the enemy will act. He sacrifices something, that the enemy may snatch at it.

20. By holding out baits, he keeps him on the march; then with a body of picked men he lies in wait for him.

21. The clever combatant looks to the effect of combined energy, and does not require too much from individuals. Hence his ability to pick out the right men and utilize combined energy.

22. When he utilizes combined energy, his fighting men become as it were like unto rolling logs or stones. For it is the nature of a log or stone to remain motionless on level ground, and to move when on a slope; if four-cornered, to come to a standstill, but if round-shaped, to go rolling down.

23. Thus the energy developed by good fighting men is as the momentum of a round stone rolled down a mountain thousands of feet in height. So much on the subject of energy.

Figure 3: The original text of chapter 5, as translated by L. Giles.

2.1 Analyzing Text Using Mind Maps

A digital mind map is essentially text formatted in a tree structure. We tried to keep the formatting as simple as possible: although the tools allow pictures, colors, various shapes of nodes and more, we thought that this would not enhance the clarity of our analysis. We did not add any text to the mind map, except for some categorizations, as explained below. Sometimes we removed text, when it seemed duplicate or not adding meaning after text restructuring. The process of analyzing text using a mind map is roughly as follows:

- Import the original text, chapter by chapter, into a mindmap. We made a separate mind map for each chapter.

- The chapter title becomes the root node in the mindmap for that chapter. Each paragraph becomes a sub-node.

- Next, each sub-node is split into further sub-nodes. This is a subjective analytical process, but there were some rules to guide us.

  - The occurrence of certain words such as hence or therefore (故 in Chinese) would cause a sub-node to de made. See also the discussion about 故 in the section about conditionals.
  - Almost every chapter contains one or more enumerations. These can be shown as sub-nodes of the enumerated concept.
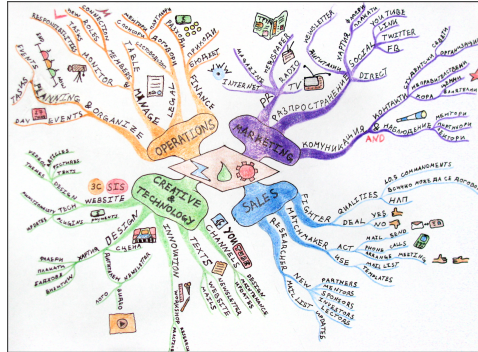
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Figure 4: Example of a mind map

To give an impression of what the result of our mind mapping work could be, we colored the mind map of chapter 1, to show the patterns we found. See figure 5

The coloring cannot be completely exact: for example, we were not able to show opposite pairs clearly. See also the deception category, where on almost every line there is a pair of opposites, but they are colored green because of the conditions that are expressed. One reason is that Freemind does not allow us to color part of a node. Another reason is the overlap of patterns used.

In the sections for each pattern: Pairs of Opposites, Enumerations, Conditional Sentences, Preference Order and Implications, we describe each of them, with examples. For the first six chapters these examples should give a complete overview of what we found.

3   Pairs of Opposites

Opposite pairs are groups of two items which have meaning that is opposite, like regular and irregular, front and back, and so on. This must be related to the yin-yang principle of ancient China, which stems from roughly the same era. Yin and yang describes how seemingly opposite or contrary forces may actually be complementary, interconnected, and interdependent in the natural world, and how they may give rise to each other as they interrelate to one another. (source: Wikipedia).

We scanned the first six chapters of "the Art of War" to find the pairs of opposites. Below you see a list of what we found.
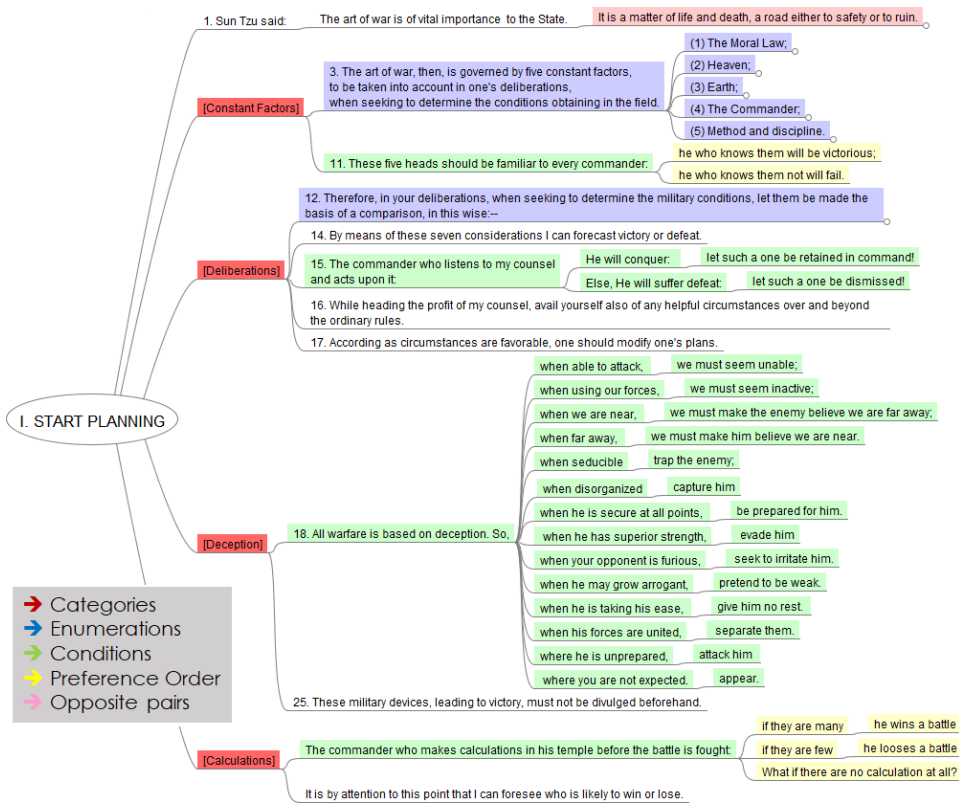
Figure 5: The mind map of chapter 1.

Chapter 1:

- Life and death

- night and day, cold and heat, times and seasons

- great and small; danger and security; open ground and narrow passes

- Deception, see the figure for the final mind map detail in Conditional Statements pattern

Chapter 3:

- intact, destroy

Chapter 5:

- weak and strong

- direct and indirect

- heaven and earth

- sun and moon

- strength and weakness

Chapter 6:

- weak points and strong

- at ease and harass

- supplied with food and starve

- encamped and move

- attack and defend

- concentrate and divide

- whole and separate parts

- front and rear, left and right, reinforce and weaken

- avoid strong and strike weak

4   Enumerations

In almost every chapter Sun Tzu used some form of enumeration of things or concepts, in several chapters even two. For example,

- the seven military considerations in chapter 1

- the five essentias or victory in chapter 3

- the nine varieties of ground in chapter 11

There are 15 enumerations in total in Sun Tzu's book, look in the details section for snippets from mind maps and for more explanation. In addition to explicit enumerations, there is mention of numbered things, such as five colors (chapter 5), without saying what they are.

A very different kind of grouping that occurs in Sun Tzu's book are groups of two, used as *pairs of opposites*. We think that the special meaning and frequent use of those pairs warrants description as a separate pattern.

The enumerations found in Sun Tzu's book are shown in the mind map in figure 6, together with a number of the chapter where they occur. As you can see, there are enumerations in all chapters, except 2 and 7. In chapter 5 and 6 Sun Tzu mentions numbered items without enumerating them explicitly. This shows that Sun Tzu found it useful to clarify his reasoning by summing up circumstances or subjects of his rules.
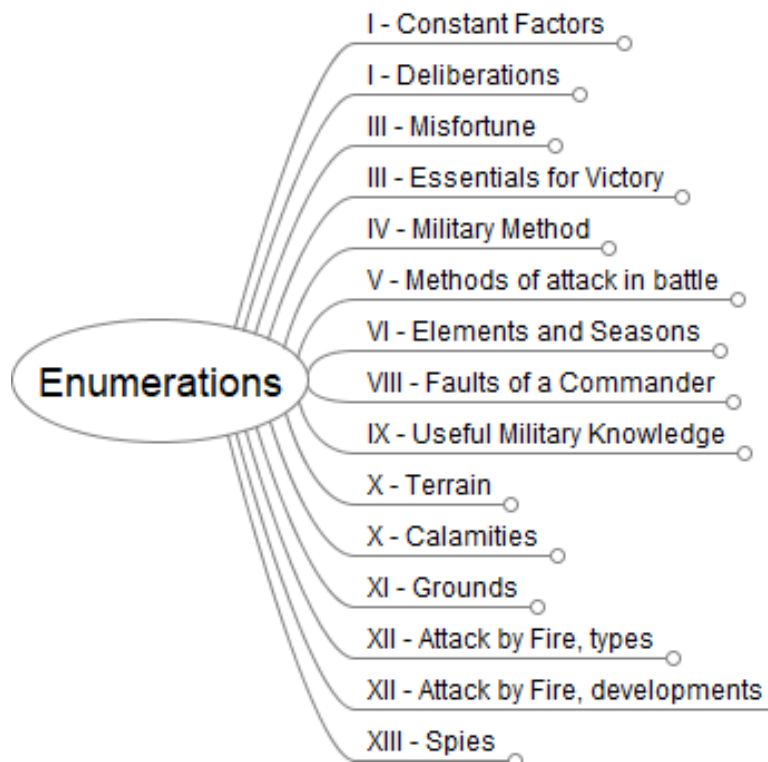

Figure 6: Enumerated Concepts

Chapter 1: *5 Constant Factors*

(1) The Moral Law; (2) Heaven; (3) Earth; (4) The Commander; (5) Method and discipline.

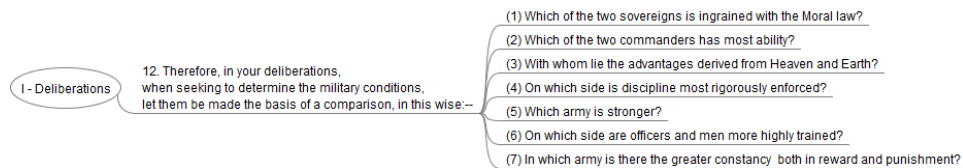**Chapter 1: *7 Deliberations***

See figure 7.

Figure 7: I-Deliberations

The last paragraph in this chapter starts with:

- The five elements (water, fire, wood, metal, earth) are not always equally predominant;

- The four seasons make way for each other in turn.

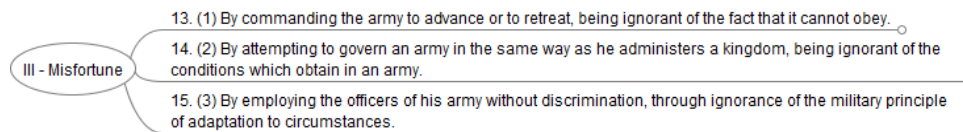**Chapter 3: *3 Ways of Misfortune***

See figure 8.

Figure 8: III-3 Ways of Misfortune

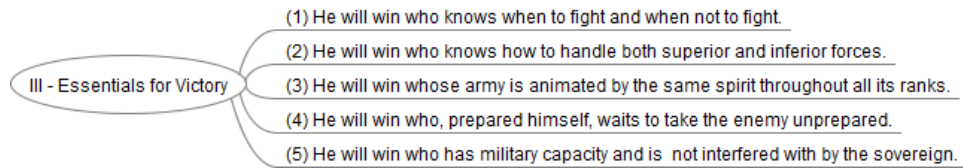**Chapter 3: *5 Essentials for Victory***

See figure 9.

Figure 9: III-5 Essentials for Victory

Chapter 4: *5 Factors for Military Method*

The original English text reads like this:

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17. In respect of military method, we have,
firstly, Measurement; secondly, Estimation of quantity; thirdly, Calculation;
fourthly, Balancing of chances; fifthly, Victory.

18. Measurement owes its existence to Earth;
Estimation of quantity to Measurement;
Calculation to Estimation of quantity;
Balancing of chances to Calculation;
and Victory to Balancing of chances.
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This enumeration posed an interesting problem of putting it in a mind map. Most translations refer to the previous enumerated item backwards: *Analysis is determined by Earth*, and so on.

However, this does not look good in a mind map and more careful study of the Chinese text leads us to believe that forward reference is much better and more true to the original text.

Therefore we constructed the texts as: *Earth determines Analysis*, and so on. See figure 10. This is reflected in the Chinese mind map (figure 11). It also shows that mind maps can be helpful in finding the right translation.

To make the enumeration more clear, we could represent the text also as in figure 12:
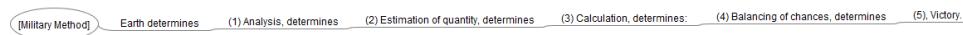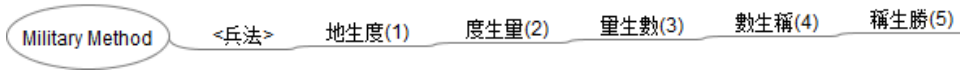

Figure 10: IV-Military Method

Military Method <兵法> 地生度(1) 度生量(2) 量生數(3) 數生稱(4) 稱生勝(5)

Figure 11: IV-Military Method; Chinese text

[Military Method] Earth determines
(1) Analysis, determines:
(2) Estimation of quantity, determines:
(3) Calculation, determines:
(4) Balancing of chances, determines:
(5), Victory.

Figure 12: IV-Military Method; alternatve version

Chapter 5: *From Five to Infinity*

See figure 13. This is an example of grouping where the items are not explicitly given, presumably because they are considered well known. From the commentary of the old Chinese scholars we know now what they are and also Giles mentioned them by name in his translation.

The items in these groups are:

- Five musical notes: the classical Chinese pentatonic scale.

- Five primary colors: blue, yellow, red, white, and black.

- Five cardinal tastes: sour, acrid, salt, sweet, bitter.

Sun Tzu is explaining here that there are an infinite number of strategies that can be used for warfare, even if the components of such a strategy are limited.
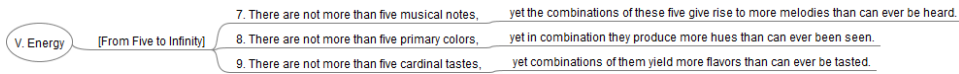
V. Energy [From Five to Infinity]
7. There are not more than five musical notes, yet the combinations of these five give rise to more melodies than can ever be heard.
8. There are not more than five primary colors, yet in combination they produce more hues than can ever been seen.
9. There are not more than five cardinal tastes, yet combinations of them yield more flavors than can ever be tasted.

Figure 13: V-Energy; from five to infinity

Chapter 6: *Elements and Seasons*

The last paragraph in chapter 6 starts with:

- The five elements (water, fire, wood, metal, earth) are not always equally predominant;

- The four seasons make way for each other in turn.

Remaining enumerations

In the remaining chapters, there are also enumerations which we only list here for completeness:

- Chapter 8: *5 Faults of a Commander*

- Chapter 9: *4 Useful branches of Military Knowledge*

- Chapter 10: *6 Kinds of Terrain*

- Chapter 10: *6 Calamities*

- Chapter 11: *9 Varieties of Ground*

- Chapter 12: *5 Ways of Attacking with Fire*

- Chapter 12: *5 Possible Developments when Attacking with Fire*

- Chapter 13: *5 Types of Spies*

As this list shows, Sun Tzu has a preference for the number five, which according to the translator Peter Harris, caused by its prevalence in early Chinese culture, see his comment at the end of chapter 4 of his Sun Tzu translation.

5   Conditional Sentences

Sun Tzu frequently employs reasoning in his text, like this:
If victory is long in coming, then men's weapons will grow dull and their ardor will be damped.
This is an example of a conditional sentence. Basically, conditionals may be of two types:

- the first one is a condition that describes a status or situation,

- the second one is a condition that should lead to an action.

Here are a few examples from chapter 1 that show conditional sentences used by Sun Tzu:

Chapter 1, sentence 15.

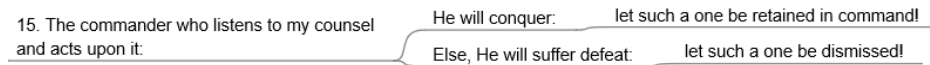The English mind map is presented in figure 14:

Figure 14: Council for the commander

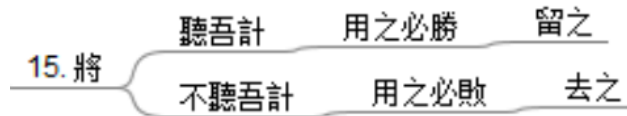The Chinese mind map is presented in figure 15.

Figure 15: Council for the commander; Chinese mind map

This discusses two conditions of a general: (1) the generals that follow your command, and (2) the generals that do not follow your command. For (1), you keep them, and for (2) you dismiss them. Sun Tzu also gives reasons for why you react differently to these two groups of generals - for (1) they will conquer, and for (2) they will suffer defeat.

This is a very neat thumb-rule for evaluating your generals, using a clear one-cut separation.

Chapter 1, Sentence 19-24.

Sun Tzu considers in chapter 1, paragraph 18-25, at how to deceive the enemy and when. The text as given by Giles, looks like this:

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18. All warfare is based on deception.
19. Hence, when able to attack, we must seem unable; when using our
forces, we must seem inactive; when we are near, we must make the
enemy believe we are far away; when far away, we must make him
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believe we are near.
20. Hold out baits to entice the enemy. Feign disorder, and crush him.
21. If he is secure at all points, be prepared for him.
If he is in superior strength, evade him.
22. If your opponent is of choleric temper, seek to irritate him.
Pretend to be weak, that he may grow arrogant.
23. If he is taking his ease, give him no rest.
If his forces are united, separate them.
24. Attack him where he is unprepared, appear where you are not expected.
25. These military devices, leading to victory,
must not be divulged beforehand.
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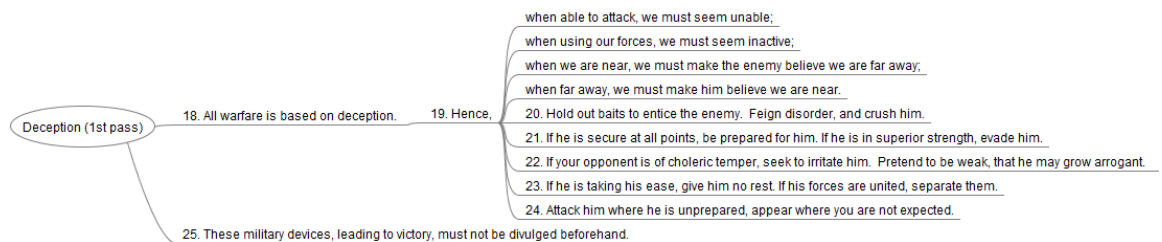This could be structured as in figure 16:

Figure 16: The first pass mind map detail.

The Chinese version is shown in figure 17.

We notice that the English translation makes use of different expressions to translate this list of conditions: *when, to, if, where.* In the original Chinese text, as you can see from the Chinese mind map, these sentences all follow a clear structure:

(in case of) A, do B.

A is some possible condition of your enemy: able to attack, using their forces, getting close etc., and B is what Sun Tzu suggest you to do under each condition: make them unable, make them unable to use their forces, get away from them, etc.

The 而 (ér) character indicates the logical relation between condition A and your reaction B, and the character 之 (zhī) is the Chinese work refers to the enemy.

The improved English translation and structure results in the mind map shown in figure 18:

	能	（而示之）不能
	用	（而示之）不用
	近	（而示之）遠
	遠	（而示之）近
	利	（而）誘（之）
	亂	（而）取（之）
	實	（而）取（之）
19–24. 故	強	（而）避（之）
	怒	（而）撓（之）
	卑	（而）驕（之）
	佚	（而）勞（之）
	親	（而）離（之）
	攻	其不備
	出	其不意

Figure 17: The first pass mind map detail; Chinese version.

Chapter 1, Sentence 26.

The English text is as follows:

26. Now, the commander who wins a battle makes many calculations in his temple before the battle is fought. The commander who loses a battle makes only few calculations beforehand. Thus do many calculations lead to victory, and few calculations to defeat.

What if there are no calculation at all! It is by attention to this point that I can foresee who is likely to win or lose.

This text is transformed into the mind map in English shown in figure 19. And figure 20 presents the Chinese mind map.

This paragraph contains both conditions and preference orders.

First two conditions are distinguished:

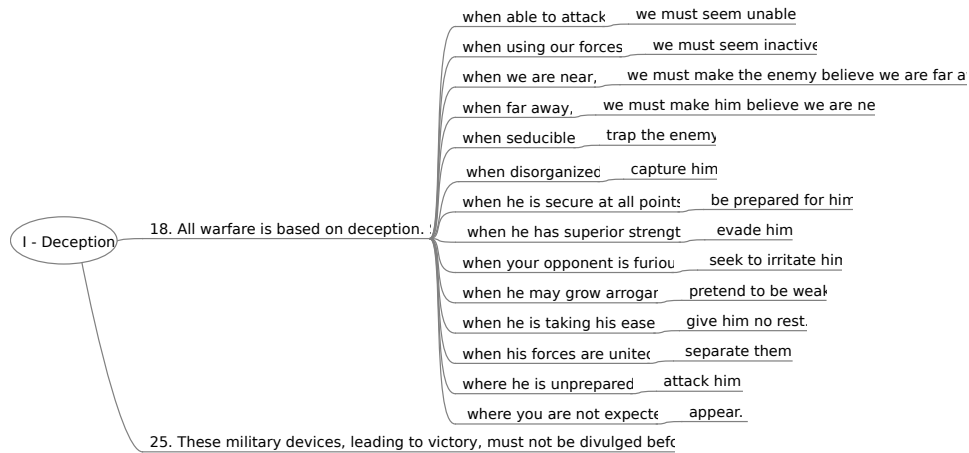1. The commander makes many calculations in his temple before the
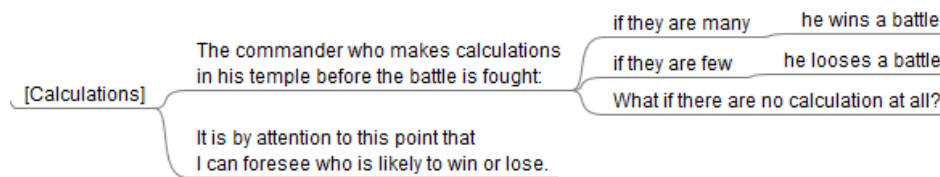
Figure 18: The final mind map detail.

Figure 19: Calculations.

  battle is fought

2. He makes few calculations beforehand.

Condition (1) leads to victory, and condition (2) leads to defeat. From these two observations, Sun Tzu asks the rhetorical question that, since more calculations leads to victory and less to defeat: what would happen if you do not make any calculations at all?

As we will see in the section about the preference order pattern, Sun Tzu structures the text in such a way that the most desirable option is mentioned first, a less desirable option next, and a condition that should not happen at all, last.
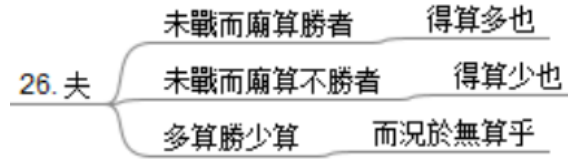
Figure 20: Calculations; Chinese mind map.

6 Preference Order

Preferences are conditional statements which assume a certain order in their execution. Sun Tzu uses this construct at several occasions, indicating good and not-so-good ways of performing warfare.

Definition of Preference Order

In logic and mathematics, *preference* is usually defined as an ordering of given elements in a set. These elements can be some objects, or possible outcomes of certain actions, and the ordering is usually defined by a utility function that weights how preferable an element is. *An element A is more preferable than element B if and only if A's utility is higher than B's.*

In the context of Sun Tzu, the author does not explicitly define preferences in such a rigid way. However, when multiple possible situations are being articulated, Sun Tzu indeed gives them a preference order.

We call this ordering preference order mainly for two reasons:

1. For each of the element being mentioned, you can always find a preference relation, and there's no circle-back.
   If A is more preferable than B, B is more preferable than C, then it implies that A is more preferable than C.

2. They are in coherence with Sun Tzu's general philosophy of war. Sun Tzu is not ordering these possible outcomes randomly, but follows his reasoning in evaluating these conditions.

6.1 Examples of Preference Order

We show here some examples of sentences using a preference order.

Chapter 01, sentence 26.

```
Now the general who wins a battle makes many calculations in his temple before the ba
The general who loses a battle makes but few calculations beforehand.
Thus,
do many calculations lead to victory,
and few calculations to defeat:
how much more no calculation at all!
```

There are three conditions to order. The most preferable one is to do many calculations that lead to victory, and the second prefer one is to do few calculations (which leads to defeat). The least preferable one, is to do no calculation at all. The Chinese mind map is shown in figure 21.
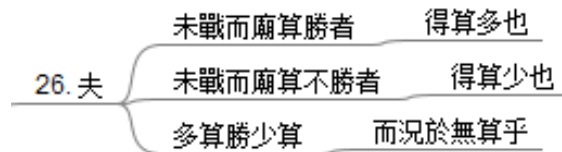

Figure 21: Preferences of calculations before; Chinese mindmap

Chapter 03, sentence 1.

```
In the practical art of war,
the best thing of all is to take the enemy's country whole and intact;
to shatter and destroy it is not so good.
So, too, it is better to recapture an army entire than to destroy it,
to capture a regiment, a detachment or a company entire than to destroy them.
```

Figure 22 shows the mind map for the Chinese text.

This example orders five elements: 國 the entire country , 軍 is the full army of the country , 旅 is a sub-unit of the country. The remaining two 卒 and 伍 are smaller units.

For each of the elements, to keep it intact is better than to destroy it.

Taking all the five elements into consideration, to keep the higher ordered one is preferable than to keep the lower ones.

Figure 22: Better capture than destroy; Chinese mindmap

This constructs a nested preference order of the five elements.

This analysis allows us now to improve the English mind map in figure 23 and the translated text.
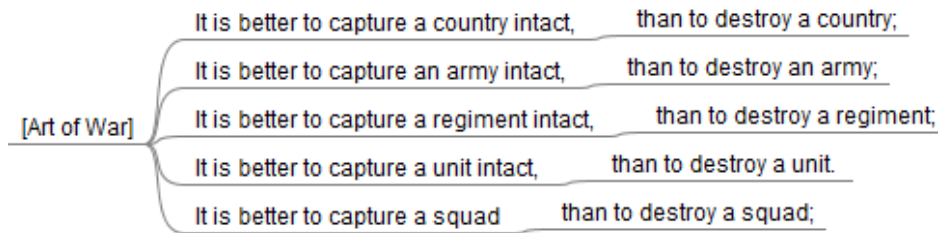

Figure 23: Better capture than destroy; English mindmap

Chapter 3, Sentence 3.

```
Thus the highest form of generalship is to balk the enemy's plans;
the next best is to prevent the junction of the enemy's forces;
the next in order is to attack the enemy's army in the field;
and the worst policy of all is to besiege walled cities.
```

Figure 24 shows the mind map for the Chinese text.

This one orders four strategies. The most preferred is from the planning perspective, then the forces, then the army, and last to besiege a city.

The world is not a perfect one, therefore when the best scenario cannot happen, Sun Tzu lists a second-best one, and then the next, thus one doesn't have to drop to the worst option immediately. By preference order, Sun Tzu provides a more refined granular view of strategies. It is not about A or not
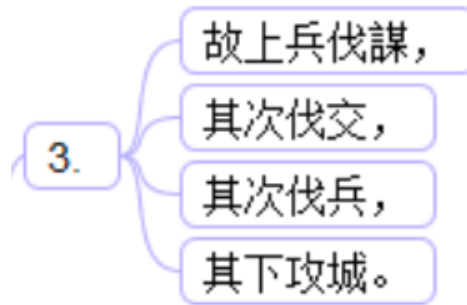
Figure 24: Better employ nonviolent strategies; Chinese mindmap

A, but we can rate from the the more preferable to the least preferable, and the possibility to make each sub-optimal scenario to happen.

7 Implications

Implications (故 gù, therefore), are used to find rules and reasoning.

From our look at the word-for-word translation in Zieger, Sun Tzu's Original Art of War, there appears to be an issue that needs to be clarified. Zieger says that this Chinese character in modern Chinese may indeed mean hence or therefore, but that in classical Chinese this word is much weaker and just means a comma, or at its best so. Therefore he omits gù in his translation.

If we read Zieger's translation of chapter 4, we think that the meaning of the text is less visible and it is more difficult to find the categories that we found for the mind map.

Our investigation and communication with our Chinese contacts lets us conclude this:

- It's true that "gù" does not imply strong causal relation as in modern Chinese, but even as "so" in the weak sense, it still reveals information about the implicit logic behind the text. It is not a good idea to omit such a strong indication of a pattern completely from the text.

- Sentences containing gù could express steps towards a conclusion, where the gù marks the start of the description of the conclusion.

In Xizhou (1046BC - 771 BC), 故 is already taken as a cause-and-effect conjunction.

In bronze inscriptions researchers found four appearances of 故 that clearly refers to 'therefore', 'hence,' 'so'. In ancient written classics that recorded Xizhou inscriptions, there are also two occurrences of gu that serves as the cause-and-effect conjunction.

Some researchers claim that sometimes 故 just refers to the next sentence, without a cause-and-effect indication. This occurs later, during the Qin and Han dynasty. This usage of 故 is also rare, while in the majority of cases gu serves as the cause-and-effect conjunction. Shi-gu (是故) indicates strong and clear cause-and-effect relation between two sentences, and this point is a common agreement among scholars in ancient Chinese studies.

Let us look at two examples of the usage of 故 (gù) in chapter 4, in the Giles translation.

- Par. 3, Thus the good fighter is able to secure himself against defeat, but cannot make certain of defeating the enemy.

- Par 4, Hence the saying: One may know how to conquer without being able to do it.

There is a clear causal correlation with the paragraph before: *To secure ourselves against defeat lies in our own hands, but the opportunity of defeating the enemy is provided by the enemy himself.*

Later in this chapter there is the sentence *To lift an autumn hair is no sign of great strength*, in Chinese: 故舉秋毫不為多力. Here the use of 故 is much less directly related with the previous sentence, which states that there is no merit in easy victories.

Our conclusion is that interpreting the use 故 for causal reasoning will be mostly fine, while in some cases we do not understand well enough what was intended to be able to judge.

For more information, see the articles from Zhigang Mao [26] and Cheng Zhang [27].

In the appendix A we present some data about the distribution of occurrences of 故 and the English equivalents (hence, therefore, thus).

8 Translations of Sun Tzu, the Art of War, into English

The history of the translations is interesting in itself, because most translators seem to be of the opinion that they improved significantly on what their predecessors did.

The first known translation into English was done by Captain E.F. Calthrop in 1905, with improvements in 1908 [6]. Lionel Giles must be the second translator, motivated to do this translation because he thought that the translation by Calthrop was "excessively bad" [8, 7]. Giles has abundant notes and explanations in his text.

Dr. Giles, in justifying his translation, wrote: "It was not undertaken out of any inflated estimate of my own powers; but I could not help feeling that Sun Tzu deserved a better fate than had befallen him, and I knew that, at any rate, I could hardly fail to improve on the work of my predecessors."

It would take about 50 years before another translation was made by Samuel B. Griffith [13].

More recent translations were done by: Cleary (1988) [10, 11], Ames (1993) [9], Sawyer (1994) [15], Wu Rusong (1999) [22], Minford (2002) [14], Lin Wusun (2003) [17], Mair (2007) [16], the Denma translation group (2009) [19], Zieger (2010) [18] and Harris (2018) [20]. Recently an illustrated commic edition was produced by Tsai (2018) [21].

The translations are substantially different and it is difficult to decide whether the exact concepts from the old text are used. Moreover, the source text is of course written in ancient Chinese, yielding additional problems, also for modern native Chinese scholars.

We use mainly the translation into English by Lionel Giles, one of the oldest translations, made in 1910. This text is available as part of the Gutenberg project [7] and is therefore freely available without copyright restrictions. Although there are later translations based on more modern research and on Chinese texts that were found during later excavations, notably in 1972, we think that the Giles translation is most suitable for our purpose: the translation is highly structured and because of its unrestricted availability we can transform the text to highlight this structure and the rules behind it. We consulted newer translations to check that understanding of the text is not completely dependent on the Giles translation.

Finding the right meaning and translate it the right way remains tricky, as is illustrated by three different translations of a famous sentence in chapter 4:

- From the Computer Game "Civilization IV", Military Tradition splash screen:

    Victorious warriors win first and then go to war, while defeated warriors go to war first and then seek to win.

- From the translation of Andrew W. Zieger:

> A winning army wins first and then seeks battle. A losing army first battles, and then seeks to win.

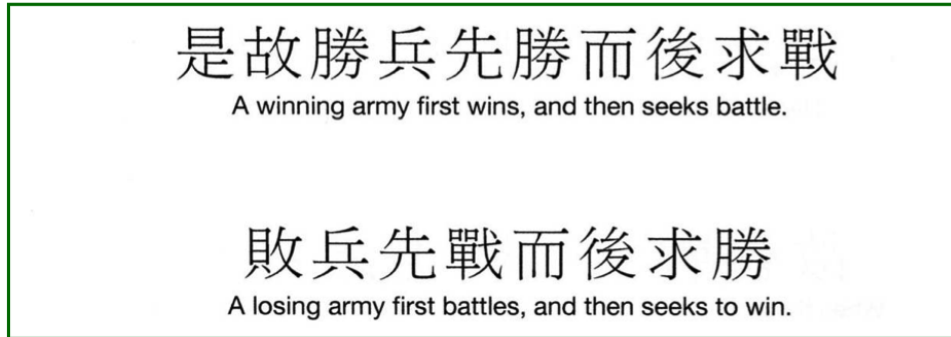See also figure 25 to view the original Chinese text. Note that the Chinese text actually starts with *therefore.*

是故勝兵先勝而後求戰
A winning army first wins, and then seeks battle.

敗兵先戰而後求勝
A losing army first battles, and then seeks to win.

Figure 25: A winning army, excerpt of the translation by Andrew Zieger.

- From Lionel Giles, par. 15:

  > Thus it is that in war the victorious strategist only seeks battle after the victory has been won, whereas he who is destined to defeat first fights and afterwards looks for victory.

We can conclude from these examples that the word *bing* has been translated to single soldier, commander or the whole army. It can also mean weapons, or military. The use of the translation *warrior* in this context only appears in the Cleary edition [10] where it occurs in a commentary to the final sentence of chapter 1, ascribed to Zhang Yu, a commentator who lived during the Sung Dynasty (960-1279 AD). Therefore the quote in the Civilization IV game is actually a quote of an ancient commentator and not of Sun Tzu himself. In Liu An [3], sect. 15.8 we find a similar sentence about soldiers.

A comprehensive discussion of the diversity of the translations is given by Yang Ming [4].

9 Conclusions

At the third conference for the forthcoming handbook on the History of logic in China, in Tianjin, 2014, one of our co-authors of the handbook expressed his opinion that the Sun Tzu's Art of War is a logic text. Subsequently, we included in our chapter about "Logical and Game Theoretical aspects of Strategy Theory in ancient China", an investigation of Sun Tzu's work using mindmap, with a focus on chapter 4.

In the work presented here we took a more thorough look at the first 6 chapters of *The Art of War*, refining the mind maps, describing all logical patterns we could find and with help of these patterns we looked at the English translations.

We have seen that the text of Sun Tzu, though not being a logic text from an orthodox contemporary perspective, is actually more structured than is usually stated. We hope to have given evidence that there is a substantial amount of logical structure hidden in the text, which can be made explicit by rendering the text as mind maps. This structure exhibits itself even stronger if you return to the Chinese source text. That it becomes less visible in the translated versions should be considered a consequence of the targets the editors and translators had in mind, aiming for the cultural and historical meaning, and the philosophy underneath the text. Even a word-for-character translation like the one of Ziegler is aimed at the language, rather than the logical structure of the text.

The use of mind maps makes it possible to uncover this logical structure even for researchers like the European authors missing a thorough background in Chinese language or philosophy. Moreover the implementation of our ideas in the Sun Tzu website affiliated with this paper,

https://suntzu.squaringthecircles.com/

presents to the public access to the text in a manner unprecedented in the literature.

A Miscellaneous Research data: Occurrences of Hence, Therefore and Thus in the translation, and Gu in the Chinese text

In this section we have accumulated some data that was used for finding structure and rules in Sun Tzu, "The Art of War".

We show here a table of the occurrences of *Hence, Therefore and Thus* as found in the translation of L. Giles [8]. The roman numerals refer to the

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specific chapter, while the numbers refer to the paragraph within that chapter.

We used these findings to determine rules in the text of the book.

Chapter	Hence	Therefore	Thus
I	2,19	12	26
II	15	17	5,9,20
III	2,10,18	6	3,7,17
IV	4,12,14		3,7,15
V	21	14	19,23
VI	8,9,14	2,32	
VII	23,23	29	4,7,25
VIII	7		
IX		43	13
X	30,31		7
XI	23,31,55	11,46	20,25,34,35
XII	13,16,22		36,55,55
XIII	7,14,25,27		3,4,21

With help of the search facility of https://ctext.org/art-of-war/ we could create the following table showing the frequency of occurrence of 故 in the Chinese text of the book, adding up to a total of 102.

ch.	Title	nr. of occ. of 故
1	Laying Plans	3
2	Waging War	8
3	Attack by Stratagem	9
4	Tactical Dispositions	10
5	Energy	6
6	Weak Points and Strong	14
7	Maneuvering	14
8	Variation in Tactics	5
9	The Army on the March	1
10	Terrain	7
11	The Nine Situations	13
12	The Attack by Fire	3
13	The Use of Spies	9

The stronger combination, 是故 (shi-gu) occurs 16 times. Looking at the first 6 chapters, our focus chapters for this study, the occurrence of 是

故 coincides with some famous quotes:

- Chapter 3:
  Hence to fight and conquer in all your battles is not supreme excellence; supreme excellence consists in breaking the enemy's resistance without fighting.

- Chapter 4:
  Thus it is that in war the victorious strategist only seeks battle after the victory has been won, whereas he who is destined to defeat first fights and afterwards looks for victory.

- Chapter 5:
  Therefore the good fighter will be terrible in his onset, and prompt in his decision.

A quick survey of the other chapters show a much less convincing pattern. Half of all occurrences (8) of 是故, appear in chapter 11, The Nine Situations. There are 4 more occurrences of (故 without 是 in this chapter. Why the text in this chapter contains so much more reasoning than the rest of the book would be an interesting subject of further study.

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