Metaphor Development in Public Discourse Using an ARIMA Time Series Analysis Approach

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Abstract

This study introduces a Time Series Analysis approach to metaphor development in a corpus of public discourse as a case study to examine the potential implications for the strategic use of metaphors in discourse over time. The corpus covers 20 years of public speeches by the government leaders in Hong Kong. We conducted an ARIMA time series modeling on the use of the frequently occurring metaphor source domains in the corpus. The ARIMA time series modeling procedures were explicitly presented, and the results were qualitatively discussed with empirical examples. We found that LIVING ORGANISM metaphors demonstrate the clearest usage profile across time, which can be attributable to the progressions of background events in the broad context based on the corpus evidence. In sum, our study emphasizes the Time Series Analysis as a complementary method offering structural insights to the diachronic study of metaphors in discourse.

1 Introduction

One primary focus of discourse research is how particular linguistic or discourse features change over time. In diachronic corpus-assisted discourse studies, the most popular way to track changes of variables of interest is to compare their occurrence frequencies between corpora in different time frames for evidence of significant differences (Tay, 2019). Statistical tools for significance tests have usually been applied to measure the degree of associations between variables and time. Recently, a few diachronic studies have emphasized the factor of time series when analyzing discourse over time (Koplenig, 2017a, b; Tay, 2017, 2019, 2021a, b; Burgers & Ahrens, 2020; Zeng, Burger, & Ahrens, 2021). These studies observed internal relationships within temporally ordered observations, known as autocorrelation, referring to the occurrence frequency of one variable at time A having influences on its corresponding occurrence frequency at time B. If we simply calculate the frequencies at times A and B and compare these frequencies using correlation tests (e.g., Pearson correlation analysis) for evidence of significant differences, we would overlook the possible presence of the autocorrelation functions between consecutive observations of the temporal data. The findings of these studies thus questioned the conventional correlation tests, which assume independent observations among temporally ordered data that lead to "incorrect statistical inference where potential effects are meaningless" (Koplenig, 2017a, p. 166).

In this study, we apply the Time Series Analysis (TSA) method to discourse research in order to address the limitations of the conventional correlation tests. We conducted a case study of metaphor use in a corpus of public discourse spanning two decades. The corpus includes public speeches delivered by the principal officials in Hong Kong from 1 July 1997 to 31 December 2017, a critical timeframe for Hong Kong as the region has transformed from a British colony to a Special Administrative Region of China. The discourse context of this study presents the data as a suitable case for an exploration of the rhetorical strategies used by Hong Kong government leaders over the first two decades of the post-handover period, during which Hong Kong has been experiencing significant social, economic, and political changes.

In what follows, we will review the existing literature on time series analysis of discourse in Section 2. Then we will introduce the data and a detailed presentation of the TSA procedures in Section 3. In Section 4, we will report the TSA modeling results followed with qualitatively contextual-based interpretations, that is, how the quantitative TSA results might provide insights into qualitative discourse analysis from actual examples of metaphors used. We will conclude this study in Section 5 by providing comparisons with previous literature and implications of applying the TSA method in discourse.

2 Time Series Analysis in Discourse

A time series refers to "a chronological sequence of observations on a particular variable" (Box, Jenkins, Reinsel, and Ljung, 2015, p. 3). Time Series Analysis is the analysis of a series of observations made across time using statistical techniques. TSA method has been explicitly introduced in Box et al. (2015). It is a process that extracts components and internal structure (autocorrelation) of the series. TSA expresses the series value at any time t as an equation of some aspect of its past values. Its equation refers to a time series model, and the structural properties of time series models can be interpreted as discourse signatures. The components of the time series include 'raw series', 'trend', 'seasons and cycles', and 'irregular fluctuation'. 'Raw series' is a plot of consecutive measurements of the variable (y-axis) against time (x-axis), e.g., monthly sales figures over 20 years. 'Trend' is a gradual long-term increase or decrease, e.g., a stable background level of economic growth. 'Seasons and cycles' are short-term oscillations due to recurrent seasonal factors or long-term oscillations due to more variable factors, e.g., sales increase during the holiday season each year and business cycles every 5-7 years. 'Irregular fluctuations' are the remainder or residuals after the above components are filtered out. This is the unpredictable component of the series, e.g., unforeseen circumstances like natural disasters and war.

Regarding TSA of discourse, Tay (2019) presented TSA's basic logic and process and its application in different discourse domains ranging from psychotherapy, academic and news discourses. A few studies focusing on political discourse have attempted to apply TSA to double-check if the observations in the diachronic data were autocorrelated (e.g., Burgers & Ahrens, 2020; Zeng, Burgers, & Ahrens, 2021). Considering the scarcity of the existing research relevant to TSA of discourse and the novelty of applying this method in discourse, in this following section, we will mainly focus on reviewing the studies in Tay (2019), highlighting the unique features of TSA in discourse study.

Tay (2019) conducted three case studies in three different discourse domains to demonstrate the feasibility of TSA for discourse analysis. In the first study, he analyzed the use of metaphors in psychotherapy sessions. The dataset includes 30 sessions from different dyads in a Chinese counseling center. The TSA modeling found a moving average (MA) model describing the use of metaphor at any interval is linearly correlated with residuals (i.e., over or underuse) two intervals prior. The qualitative interpretations of the results in this study are that "unexpected moments of metaphor-related insight have a quick but short-term impact on what happens in the immediate future" (Tay, 2019, p. 62). In addition, the generally less fit of models for metaphor use indicates that metaphor use in psychotherapy discourse is less predictable.

The second study in Tay (2019) focused on the non-informational marker (*You know, I mean, I guess, you see, sort of, let's say,* etc.) in weekly university lectures. The dataset includes transcripts of three courses in social science, science, and humanities from Yale University's Open Yale courses (https://oyc.yale.edu/courses). He found a clear autoregressive (AR) model in the use of non-informational marks in social science lectures. The non-informational marks are linearly correlated with its use in one lecture prior (past use influences future use). The interpretations are that the progressive development of informational aspects is related to the continuity of the non-informational mark use in consecutive lectures.

The third study is TSA of three thematic keywords (*democracy, terrorism,* and *communism*) in newspaper discourse. The dataset includes 37-year relevant articles from the New York Times (1980-2017). The TSA modeling results show a mean model for 'democracy', which likely indicates the long-term ideological stability of democracy in the American media discourse. There are random walk models found in describing 'terrorism' and 'communism,' and the interpretation is that terrorism and communism are more likely to be discussed spontaneously rather than at a stable level. These three case studies emphasized the potential of the TSA method to the study of language features of interest in different discourse domains.

We see that the quantitatively structural information of discourse can provide direction for subsequent qualitative interpretations. TSA method allows us to have deeper insights into how language use and the associated ideologies are systematically correlated with past uses over substantial time intervals in different contexts like psychotherapy, university lecture, and newspaper. It is thus a good complement to the existing qualitatively-based discourse studies.

In line with the above studies, we extend TSA to public discourse data to enrich the existing research on TSA of discourse. We conduct a case analysis in a corpus of public speeches by the principal officials in post-colonial Hong Kong over the past two decades from 1 July 1997 to 31 December 2017. The present variable of interest is the number of frequent metaphor source domains structured in 20 years (1997-2017) of the time series of the corpus. We aim to address the following three research questions:

1) What metaphor source domains have been used in public discourse in Hong Kong over the past two decades (1997-2017)?
2) How are metaphor source domains structured in public discourse in Hong Kong over the past two decades (1997-2017)?
3) What are the potential implications of TSA for the strategic use of metaphors in political communication?

3 Data and Method

3.1 Data

The data used in this study refers to a corpus of public speeches collected from "Speeches by Senior Officials" in Hong Kong available on the official website of the Hong Kong government (http://www.info.gov.hk/isd/speech/sensp.htm).
The corpus contains 125 public speeches with a total of 159,519 words, covering a period from 1 July 1997, the first day when Hong Kong handed over its sovereignty from Britain to China, to 31 December 2017. The speeches were delivered by the principal officials in post-handover Hong Kong, including the Chief Secretary for Administration (CSA), the Financial Secretary (FS), and the Secretary for Justice (SJ). These speeches were mostly delivered in response to various societal events, such as business forums, university anniversary ceremonies, or legislative council meetings.

3. 2 Metaphor and source domain identification

In Conceptual Metaphor Theory (Lakoff & Johnson, 1980/2003; Lakoff, 1993), metaphors are considered as cross-domain mappings from a more concrete source domain (e.g., LIVING ORGANISM) to a more abstract target domain (e.g., ECONOMY). To date, metaphor has been widely used in discourses of different areas as diverse as politics (Ahrens, Jiang, & Zeng, 2021; Lakoff, 1996/2002; Charteris-Black, 2005/2011; Zeng, Tay, & Ahrens, 2020), psychotherapy (Tay, 2013; Tay, Huang, & Zeng, 2019), advertising (Forceville, 1996; Zeng, 2019), etc.

To identify metaphors and relevant source domains used in the current corpus, two analysts with postgraduate degrees in linguistics who are experienced in metaphor analysis coded the data. Following the Metaphor Identification Procedures VU University Amsterdam (MIPVU) (Steen et al., 2010), we determine if a keyword is metaphorical or literal based on if cross-domain mappings exist between the basic meaning and the contextual meaning of the word. This approach was chosen rather than other metaphor identification approach such as the discourse dynamics approach (Cameron & Maslen, 2010) since the current study focuses on a single lexical unit (e.g., a single word) rather than large chunks (e.g., a phrase, a sentence or a paragraph) as metaphorical in order to quantify metaphor usage patterns. In total, we obtained 5,962 metaphors from the corpus.

We then identify the source domains for all the metaphors following the source domain verification approach (Ahrens & Zeng, 2017; Ahrens & Jiang, 2020). The 5,962 metaphorical instances were categorized into 20 types of different source domains. The top seven frequently occurring source domains are BUILDING (1,176 cases), LIVING ORGANISM (1093 cases), JOURNEY (975 cases), PHYSICAL OBJECT (940 cases), BUSINESS (356 cases), WAR (316 cases), and SPORT (300 cases).

3.3 The TSA procedure

The variable in this study is the number of the frequent metaphor source domains used in consecutive time intervals in the period from 1 July 1997 to 31 December 2017. The top seven frequent source domains (BUILDING, LIVING ORGANISM, JOURNEY, PHYSICAL OBJECT, BUSINESS, WAR, and SPORT) are included in the analysis. As the time frame of the corpus (1 July 1997 to 31 December 2017) includes 20 years and a half, we separated the time frame into 41 consecutive half-year intervals, which also fits the requirement of a minimal 30 observations for TSA. We aggregated the data on the half-year level, meaning every value represents the frequencies of the source domains for a half-year period (e.g., 1 July – 31 December 1997, 1 January – 30 June 1998, and 1 July – 31 December 1998). The statistical analysis of TSA follows the procedures of the Box-Jenkins TSA method (Box et al., 2015; Tay, 2019, p. 26). In what follows, we will demonstrate the TSA procedures in detail using a variable with adequate TSA model fit from the current corpus: the use of LIVING ORGANISM source domain in the 41 half-year intervals.

Step 1. Inspect the raw series to see if data transformation is needed

The software we used for generating time series models is the XLStat implemented for Microsoft Excel. Figure 1 presents the raw plot (y_t) and correlograms (ACF and PACF) of the LIVING ORGANISM over the 41 observations for the corpus.[1] As TSA estimates series properties based on a limited set of data available, to validly model the series based on just one realization requires the key properties like the mean and variance of the observed values to be constant or stationary over time. We can see from the raw plot that the values

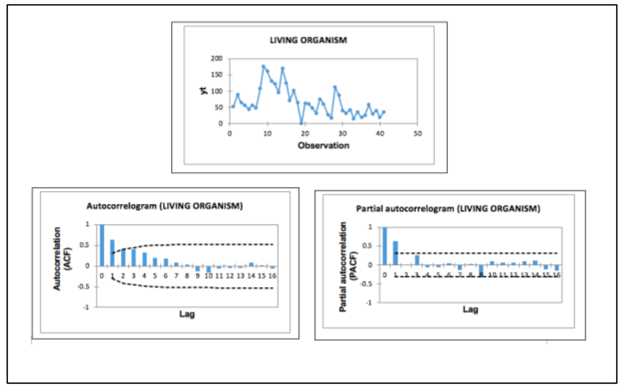


Figure 1. Plot and correlograms of LIVING ORGANISM source domain

do not appear to fluctuate around a midpoint along the y-axis, which seems to show the mean of the series is not constant, and the series is non-stationary. However, we still can't ascertain by visual observation whether the series is stationary or nonstationary. It requires more than visual inspection for making judgments. A detailed examination of the behaviors of the autocorrelation function (ACF) is needed. The ACF in Figure 1 decreases to nonsignificant levels, abruptly taking two lags to do so, which is a sign of stationarity. No transformation procedures are required in this case.

Step 2. Calculate autocorrelations based on autocorrelations

After we inspect a series that is stationary, we proceed to the next step of calculating ACF and PACF up to a specified number of lags. The calculations are automated, and it requires analysts' judgments. From the correlograms in Figure 1, we can see the ACF is significant up to lag 1, and it dies

[1] "Autocorrelation (ACF) is a measure of how successive values in a series are internally related to one another. The value of ACF at 'lag 1' is the correlation coefficient between pairs of metaphor frequencies at time x and time x+1. PACF is similar to ACF except that it measures partial correlations, that is, it controls for the values at shorter lags. For example, the PACF at lag 3 is the correlation between values at time x and time x+3, with the effects of time x+1 and x+2 removed." (Tay, 2017, p. 700).

down gradually to nonsignificant levels from lag 1. The PACF is also significant up to lag 1 and cuts off abruptly into nonsignificant levels from lag 1. There are spikes (statistically significant autocorrelations) in both the ACF and PACF up to lag 1.

Step 3. Identify candidate models

According to the basic guidelines for model selection based on ACF and PACF behavior (Tay, 2019, p. 34), the behaviors of ACF and PACF show a clear autoregressive (AR) signature. Both ACF and PACF have spiked up to lag 1 and cuts off after lag 1. In addition, the PACF cuts off more abruptly. We thus selected AR (1) model operator (Φ_1) at lag 1 as the most likely candidate model.

Step 4. Calculate parameter estimates and evaluate goodness of fit of the models

We then evaluate its goodness of fit using the XLStat in Excel, and the estimated parameters are shown in Figure 2. The mathematical form of an AR (1) model is $y_t = (1 - \Phi_1)\mu + a_t + \Phi_1 y_{t-1}$, where y_t is the present value in the series, μ is the true or "population" mean of the whole series, a_t is the present value of the residual (i.e., observed – predicted value at time *t*), y_{t-1} is the value at time *t*−1, and Φ_1 is a coefficient also known as the AR (1) operator. The parameters to be estimated are thus μ and Φ_1.

Summary statistics							
Variable	Observations	Obs. with missing data	Obs. without missing data	Minimum	Maximum	Mean	Std. deviation
LIVING ORGANISM	41	0	41	0.000	177.930	66.543	43.997

Results of ARIMA modeling of the LIVING ORGANISM series	
Results after optimization (LIVING ORGANISM):	
Goodness of fit statistics:	
Observations	41
DF	39
SSE	52728.062
MSE	1286.050293
RMSE	35.86154337
WN Variance	1286.050293
MAPE(Diff)	45.24728728
MAPE	45.24728728
-2Log(Like.)	411.3747493
FPE	1350.352807
AIC	415.3747493
AICC	415.6905388
SBC	418.8018934
Iterations	35

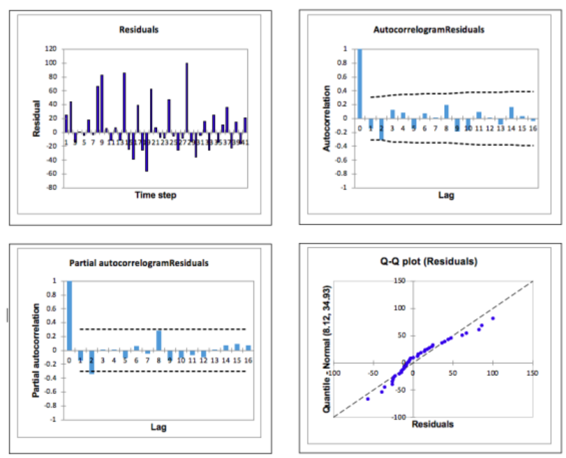
Model parameters							
Parameter	Value	Hessian standard error	Lower bound (95%)	Upper bound (95%)			
Constant	0.000	42.518	-83.334	83.334			
Parameter	Value	Hessian standard error	Lower bound (95%)	Upper bound (95%)	Asympt. standard error	Lower bound (95%)	Upper bound (95%)
AR(1)	0.880	0.066	0.751	1.009	0.074	0.735	1.025

Figure 2. Estimated parameters of AR (2) model for LIVING ORGANISM

From the statistics in Figure 2, we can see the mean μ is 66.543 and Φ_1 is 0.880 with statistical significance at 95% confidence level. The length of the bars describes the size of the (partial) autocorrelation (-1.0 to +1.0) at that lag. The standard error estimate, AIC, SBC are measures of goodness of fit with lower values preferred. The AR(1) model is thus $y_t = 7.99 + a_t + 0.88y_{t-1}$.

Step 5. Run residual diagnostics on residuals

The next step is to perform residual diagnostics to ensure that all patterns in the series have been extracted by the AR (1) model, and such series is called 'white noise'. In other words, we need to verify that there are no significant autocorrelations among the values in the residual series before using the model and parameter to forecast future values. We verify it by checking if the residuals are independent and normally distributed. Figure 3 shows the results of the residual diagnostics.



Summary statistics							
Variable	Observations	Obs. with missing data	Obs. without missing data	Minimum	Maximum	Mean	Std. deviation
Residuals	41	0	41	-56.421	100.189	8.123	35.363

Shapiro-Wilk test (Residuals)	
W	0.937
p-value (Two-tailed)	0.025
alpha	0.05

Figure 3. Residual correlation and normality diagnostics for LIVING ORGANISM

We can see there are no spikes in both the ACF and PACF for any of the lags (except lag 2 is slightly significant), indicating no significant autocorrelations in the residual series. The normality of the residuals is shown in the QQ plot depicting a roughly straight line. The Shapiro-Wilk statistics (W=0.937, P=0.025) results are also indicative of normality in the residual series with P value of 0.01 as the statistical significance cut-off. As the residual series are normally distributed and independent, the model $y_t = 7.99 + a_t + 0.88y_{t-1}$ is ascertained acceptable and can be used to forecast future values.

***Step 6.* Forecast future values if model is acceptable**

The last step of TSA is forecasting future values for the fitted model. Figure 4 shows the actual versus predicted frequencies of the LIVING ORGANISM source domain over the 41 intervals, using $y_t = 7.99 + a_t + 0.88y_{t-1}$.

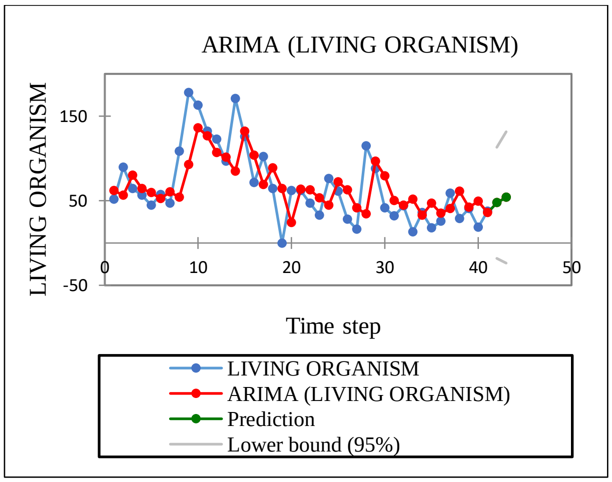


Figure 4. Predicted versus actual values of y_t

Visual inspection suggests that the fitted model has a reasonable level of accuracy and depicts the overall shape of the observed values. The sizes of the residuals vary but are small in most intervals. We can also quantify and compare this accuracy with different measures, most commonly the MAPE (Mean Absolute Percentage Error). MAPE is calculated by summing the % error [(observed – predicted) / observed * 100%] at each time step and dividing this sum by the total number of time steps. The drawback is that it cannot be used if any observed value = 0, which leads to division by zero. For the present model, if we exclude the 0 value at the 19th time step for illustrative purposes, MAPE = 26.2%, which is reasonably good for discourse data.

To forecast future values, e.g., the value at the 42nd interval, we therefore substitute the value of the residual at the 41st interval ($y_{41} = 17$) into the model: $y_{42} = 7.99 + a_{41} + 0.88*17$.

4 Results and Discussion

4.1 Results

Following the above TSA procedures, we conducted ARIMA time series modeling on the overall use of the seven source domains (BUILDING, LIVING ORGANISM, JOURNEY, PHYSICAL OBJECT, BUSINESS, WAR, and SPORT) in the corpus. Among the seven cases modeled, we found:

(a) one case with autocorrelations between time and source domain use and an ARIMA model can be fitted: the use of LIVING ORGANISM source domain over time;

(b) four cases with no autocorrelations between time and source domain use: the use of BUILDING, JOURNEY, WAR, and SPORT source domains over time;

(c) two cases with autocorrelations between time and source domain, but the autocorrelation patterns do not fit statistically straightforward models: the use of PHYSICAL OBJECT and BUSINESS source domains over time.

4.2 Discussion

In this section, we will interpret the three types of ARIMA modeling results by further examining the contexts of the metaphor source domain use at relevant junctures. Due to space limitations, we will focus on discussing the underlying reasons for the continuity in the series with ARIMA models (i.e., the use of the LIVING ORGANISM source domain over time). The emphasis of the discussion will be put on the qualitative meaning of the models and their implications for a better understanding of metaphor use in public discourse. We will also briefly mention the implications of the absence of models and complicated models when concluding this study in Section 5.

Case with autocorrelations and ARIMA model can be fitted: LIVING ORGANISM

The first type of ARIMA modeling result is the one case with autocorrelations between time and source domain use, and an ARIMA model can be applied: the use of LIVING ORGANISM source domain over time. As exemplified in Section 3.3, the profile of the LIVING ORGANISM source domain demonstrates a clear usage profile across time and is adequately described by the AR(1) model $y_t = 7.99 + a_t + 0.88y_{t-1}$. We can see from the equation, in AR models, y_t is determined by y_{t-1}, meaning the present value as a function of its past values, suggesting that LIVING ORGANISM metaphors are used with a strong degree of continuity across consecutive half-year intervals, where high levels of use tend to be immediately followed by a comparably high level of use, and vice-versa (see Figure 4). The AR (1) model indicates that the past frequencies of LIVING ORGANISM exert the maximum influence from one interval away, with gradually declining effects thereafter.

Based on the observations in the data, we found that patterns of the continuity in LIVING ORGANISM source domain use are attributable to the progress of the background events in the broad contexts. The associations between the two are detected by the AR (1) model showing a degree of continuity over consecutive half-year intervals. It is feasible to hypothesize that the potential factors that influence source domain use can be the corresponding target domains or elements in the surrounding contexts. The qualitative interpretation will then look at the LIVING ORGANISM source domain one half-year apart, focusing on the localized upward or downward movement in the same direction and their relationship with the progression of background events (e.g., social, economic, or political event development) at critical junctures.

From the raw plot of the LIVING ORGANISM source domain in Figure 1, we can see that, overall, the first half of the series has a higher magnitude of rises and falls than the second half of the series. There is a sharp rise from 7 to 9 and a sharp fall from 9 to 13. It then rises from 13 to 14 and then experiences a sharp fall from 14 to 19 with a slight rise from 16 to 17. In the second half of the series, there is a sharp rise from 27 to 28 followed by a sharp fall from 28 to 31. We select one period with a sharp rise for illustration: the rise from 7 to 9.

The rise from 7 to 9

Points 7, 8, and 9 correspond to the time intervals of 1 July – 31 December 2000, 1 January – 30 June 2001, and 1 July - 31 December 2001. The rise from 7 to 9 means there is a continually increasing use of the LIVING ORGANISM source domain from 1 July 2000 to 31 December 2001. To understand the underlying reasons for the continuity, we calculated the frequencies of the corresponding target domains and checked their surrounding contexts in each period. The results show that the LIVING ORGANISM source domain occurs most frequently when conceptualizing the target domain of ECONOMIC ISSUES. We then select data instantiating ECONOMIC ISSUES ARE LIVING ORGANISM metaphors to illustrate how the progress of the background events in the surrounding contexts causes the increasing use of LIVING ORGANISM source domains in the three consecutive half-year intervals.

The following extracts from the three consecutive half-year intervals are illustrative. Extract (1) is obtained from the speech in the first half-year interval (1 July - 31 December 2000), Extract (2) is from the second half-year interval (1 January – 30 June 2001), and Extract (3) is from the third half-year interval (1 July – 31 December 2001). Metaphorical keywords of LIVING ORGANISM source domain are italicized. The background events are in bold, and signs indicating the progress of the background events are underlined.

Extract (1): July – December 2000

"First, let me bring you up to date with how the economies of our region have been *performing* as we regain the ground lost through the impact of **the Asian financial crisis**. There's no doubt the *recovery* is taking hold. Barring any serious deterioration in the oil supply situation, forecasts indicate that the nine economies of East Asia, excluding Japan, will *grow* by an average of over 6 percent this year, and there's likely to be a similar *growth* rate in 2001." (Donald Tsang, FS, 19 September 2000)

Extract (2): January – June 2001

"The problems unearthed by **the Asian financial crisis** and the restructuring of our economy bring me to my second point, and that is the effect it has had on the psychology and confidence of our fellow citizens. Hong Kong cannot escape from that, although our China connection makes us less *vulnerable* than some of our neighbours as the Mainland economy remains in remarkably *robust health*." (Donald Tsang, CSA, 21 June, 2001)

Extract (3): July – December 2001
"I refer more particularly to how Hong Kong has dealt with the enormous challenges thrown up in the wake of **the Asian financial crisis** and September 11. These challenges still reverberate in Hong Kong today… Our GDP *growth* is contracting more sharply than we had forecast following a strong 10.5 percent rebound last year. This is obviously disappointing considering the difficulties our community endured during the tough years of 1998 and 1999 when we were caught in the wringer of **the Asian financial crisis**." (Donald Tsang, 19 November 2001)

Among all the metaphorical keywords identified for the ECONOMIC ISSUES ARE LIVING ORGANISM metaphors, '*growth*' is found to be the most frequent keyword. In Extracts (1) - (3), the use of *'growth'* and other keywords (*'recovery', 'perform', 'vulnerable', 'robust' and 'health'*) are all associated with economy-related issues, e.g., GDP or economic '*growth'*, the '*recovery'* from the impact of the Asian financial crisis and Mainland China's economy remains in '*robust health'*. We thus categorized all the metaphorical keywords under the ECONOMIC ISSUES ARE LIVING ORGANISM metaphors and found that these keywords frequently co-occur with some particular background events. The most frequently co-occurring event is the Asian financial crisis.

When looking at the history of post-colonial Hong Kong, the period July 2000 to December 2001 in question is the preliminary stage of post-colonial Hong Kong. Hong Kong suffered the Asian financial crisis in 1997 and1998. It's not surprising that during the first few years of the post-Asian financial crisis, the principal officials of Hong Kong talked more about the region's economic issues in public speeches. When conceptualizing the ECONOMIC ISSUES as LIVING ORGANISM, the speakers frequently use the metaphorical keyword of '*growth*' to emphasize the aspect of 'Hong Kong's economic growth' during these critical junctures. It thus explains why the keyword '*growth*' under the LIVING ORGANISM source domain frequently co-occurs with these specific background events.

Another aspect to be discussed is the reasons for the continuity of the LIVING ORGANISM source domain in the three consecutive time intervals. Evidence in the data shows that the progress of the background events leads to this continuity. The event of the Asian financial crisis (1997-1998) and its progress have been explicitly indicated in the three extracts (the underlined sentences). In Extract (1), the speaker mentioned the impact of the Asian financial crisis and the recovery of Hong Kong's economy is taking hold. There are forecasts indicating the economic growth in East Asia. In Extract (2), the speaker talked about the problems unearthed by the Asian financial crisis, and Hong Kong's economy is in the progress of restructuring. In Extract (3), the speaker starts to recall the history and the achievements Hong Kong has made for the last four years (1997-2001); Hong Kong's GDP growth is much greater than it was forecasted in 2000. He also refers to how Hong Kong has dealt with the influence and difficulties of the Asian financial crisis during the tough years of 1998 and 1999. Extract (1)-(3) show the clear progress of Hong Kong's economic recovery and growth in the post-Asia financial crisis. The crisis was first mentioned in terms of its impact in the first half-year interval; the economic problems were unearthed in the second half-year interval; Hong Kong tackled the difficulties and made economic growth and achievements in the third half-year interval. The TSA modeling thus contextualizes the sharp rise against a larger background of usage.

5 Conclusion

This study emphasizes the potential of the TSA method for the study of metaphors in discourse. TSA modeling results reflect whether and how metaphor usage patterns are systematically structured in public discourse across time. We only found LIVING ORGANISM metaphors demonstrate the clearest usage profile across time, which can be attributable to the progressions of background events in the broad context based on the corpus evidence. The continual use of LIVING ORGANISM metaphors implies particular communication purposes by the speakers at particular times. The analysis thus sheds new light on the diachronic changes of metaphors in corpus and the potential implications for the strategic use of metaphors in political communication.

We also found the four cases with no autocorrelations between time and source domain use (BUILDING, JOURNEY, WAR, and SPORT source domains) and two cases with complicated autocorrelations but do not fit statistically straightforward models (the use of PHYSICAL OBJECT and BUSINESS source domains over time). The majority of the cases are without significant autocorrelation or with complicated autocorrelation, which affirms the claim that discourse phenomenon is messy in nature and less predictable by quantitative analysis using statistical methods. However, this study shows that TSA is a practical method that is able to connect temporal variables to discourse variables in a systematic and replicable way. It is of great significance to offer complementary structural insights into the qualitative interpretations of how a discourse feature (e.g., metaphor) changes across time.

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