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Time series analysis of discourse: A case study of metaphor in psychotherapy sessions

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Abstract

Time series analysis (TSA) is a technique to describe the structure and forecast values of a particular variable based on a series of sequential observations. While commonly used in finance and engineering to understand structural changes across time, its applicability to humanistic processes like discourse is less clear. This paper demonstrates the feasibility and complementary use of TSA with a case study of metaphor use in psychotherapy sessions. A conceptual sketch of how TSA components (trends, seasons, cycles, irregular fluctuations) relate to discourse components is followed by a step-by-step analysis of two therapist-client dyads. Each dyad is shown to be adequately described by a different model, and the key characteristics of the models are interpreted alongside prior qualitative analysis of the dyads, shedding new light on their structural properties and attendant implications. Limitations of the present analysis and future research directions are briefly discussed.

Keywords

Time series analysis, discourse structure, metaphor, psychotherapy

Introduction

A time series is a set of sequential observations on one or more variables. Examples include stock markets, sales figures, rainfall, and birth/death rates. Since observed values in naturally occurring time series are often dependent on earlier values, techniques of time series analysis (TSA) exploit this dependence (or autocorrelation) to describe latent underlying processes and forecast future values. TSA is most useful in cases where the data exhibits constant structural changes rather than deterministic patterns of increase or decrease, as typically seen in standard regression models with cross-sectional and mutually independent observations.

TSA is an obvious analytical strategy in fields like finance and engineering where most phenomena are directly quantifiable and change in ways which reflect complex underlying processes. Its applicability to more humanistic processes such as discourse is less clear. Imagine, however, a context where the strategic use of some language or discourse feature is (partly) characterized by its changing frequencies across a well-defined time period. Examples include consecutive news coverage of an extended event, or therapist-client talk across multiple psychotherapy sessions. The description and forecasting of features of interest with reference to their autocorrelational structure may shed new light on how discourse develops in motivated ways. Conversely, rich contextual descriptions of discourse events often seen in conventional discourse analytic research may offer new grounds to explore the qualitative explanatory power of TSA models.

This paper demonstrates the feasibility and complementary use of TSA with a case study of metaphor use in psychotherapy sessions. I begin with a brief overview of related research to establish psychotherapy as a chronologically well-structured discourse context, where the modeling and forecasting of strategic features like metaphor could be of interest to discourse analysts and practitioners alike. This is followed by a conceptual sketch of how major components of a typical TSA dataset in economics (i.e. trends, seasons, cyclic movements, irregular fluctuations) might also manifest in metaphor and discourse data. The widely used Box-Jenkins time series methodology (Box and Jenkins, 1976) will then be applied to model metaphor frequencies from two therapist-client dyads. One of these dyads will be shown to be adequately defined by a particular time series model. The other dyad will illustrate the case where no suitable model can be found, such that there is no superior estimate than the mean frequency of the series. I then adopt a more speculative tone to interpret these results from a qualitative angle; i.e. how the statistical characteristics of the models might relate to discourse analytic insights from actual examples of metaphors used, and what this may suggest about the general dynamics of metaphor in psychotherapy. I conclude with a critical discussion of the limitations of TSA for discourse analysis, while suggesting some possibilities to extend the present exploratory work.

Metaphor use in psychotherapy as time series

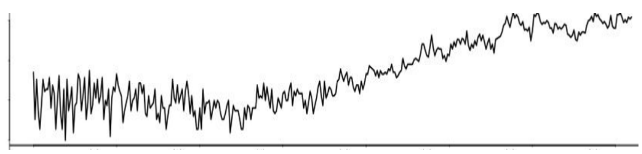
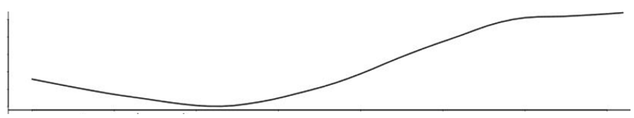
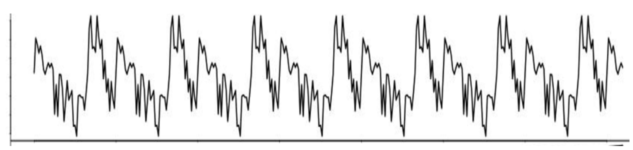
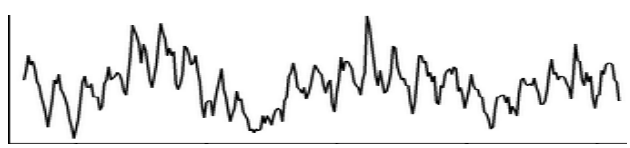
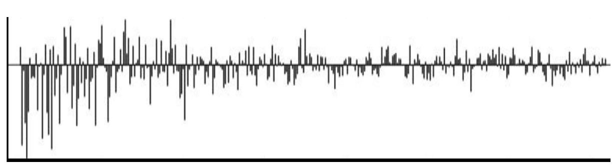
Psychotherapy is a verbal activity where therapists apply clinical methods and interpersonal stances to assist clients to modify their behaviors, cognitions, emotions, and/or other personal characteristics (Norcross, 1990). There are many different types of psychotherapy but their common linguistic nature has made it a prime context for studies of language and interaction from a variety of theoretical perspectives, ranging from conversation analysis (Peräkylä et al., 2011) to pragmatics (Labov and Fanshel, 1977; Needham-Didsbury, 2014) and sociolinguistics (Ferrara, 1994). Reciprocally, the potential clinical implications of such analyses have also been highlighted in the psychotherapy literature (O’Reilly and Lester, 2016; Spong, 2010). Linguistic and discursive features such as topic shifts (Sutherland and Strong, 2011), modalizers (Martinez et al., 2012), and indeed metaphor (Tay, 2013) – just to name a few – are seen as possible indicators of therapeutically relevant processes, and/or markers of client change. In the case of metaphor, the basic premise is that it allows clients to express complex issues and emotions which are difficult to describe in literal terms (McMullen, 1996). Different major theories of metaphor have been considered. The influential conceptual metaphor theory (Lakoff, 1993), which focuses on how metaphoric language reflects entrenched associations between conceptual domains, dovetails with cognitive therapeutic approaches (e.g. Cognitive Behavioral Therapy) which attribute non-ideal behaviors to non-ideal conceptualizations (Stott et al., 2010; Wickman et al., 1999). Theories which emphasize the cultural, contextual, and discursive basis of metaphor (Cameron et al., 2009; Quinn, 1991) have also lent to discussions on important therapeutic notions such as cultural sensitivity (Dwairy, 2009) and therapist-client collaboration (Lyddon et al., 2001).

While metaphor discourse analysts are more interested in how the psychotherapy context modulates metaphor use, mental health researchers and practitioners tend to focus on metaphors as intervention tools (Blenkiron, 2010; Kopp and Craw, 1998) and markers of client change. Levitt, Korman and Angus (2000) compared clients' use of 'burden' metaphors between dyads with good and poor outcomes, and found that only the former saw a gradual transformation from metaphors of 'being burdened' to metaphors of 'unloading the burden'. Likewise, Sarpavaara and Koski-Jännes (2013) examined clients' use of 'journey' metaphors, reporting that those who construed themselves as active destination seekers (e.g. 'the direction is correct, but still there's a need to continue the journey, to keep going in the same direction') recovered better than those who did not (e.g. 'when the time comes, one sort of finds his own path'). These studies focus on different aspects of metaphor use but commonly regard time as an implicit predictor of usage patterns which bear therapeutic implications.

Since psychotherapy usually has a well-defined chronological structure of regular sessions where past sessions are expected to have some bearing on the content of future ones, it seems reasonable to investigate the temporal factor more explicitly with a methodology like TSA. The specific TSA aspects of modeling and forecasting are likely to interest metaphor discourse analysts and practitioners alike. As previously mentioned, time series models can formalize underlying structural regularities invisible to qualitative analysis alone, and are themselves potentially amenable to qualitative interpretation in different contexts. The notion of 'forecasting' discourse may seem somewhat counter-intuitive to its supposed spontaneity, but it could help therapists gauge likely future responses from clients, plan their interventions accordingly, and perhaps conduct comparative analyses across individuals, dyads, types of therapeutic approach, and so on. For the discourse analyst, the outcome of TSA can offer a starting point for closer qualitative scrutiny, and/or motivate (re)analysis of previously analyzed examples - as will be illustrated in this paper.

Major components of time series data

The plausibility of TSA for (metaphor) discourse analysis can be assessed by considering how the key characteristics, or components, of a typical TSA dataset might have counterparts in discourse data. Table 1 shows some typical data of a company's 'raw' twenty-year monthly sales figures, subsequently decomposed into the key components of trend, seasonality, cyclic movement, and irregular fluctuation. TSA extracts information from the first three components until irregular fluctuations, or ‘white noise’; i.e. the unpredictable part of the data is left (Vandaele, 1983). The resultant combination of the equations best describing these components constitutes the best time series model.

Component	Examples
Raw data A plot of the observed variable (y-axis) against time intervals (x-axis) (e.g. twenty-year monthly sales figures)	
Trend Gradual, long-term (>1 year) increase/decrease in the underlying level of the series. May be linear or non-linear	
Seasonality Short-term (<1 year) oscillations due to ‘seasonal’ factors which repeat from one period to the next. Often subsumed within a larger trend	
Cyclic movement Gradual, long-term oscillations around a trend. Unlike seasonal oscillations, the length of each period/cycle is not known beforehand, and the variation is often smaller	
Irregular fluctuations / white noise Sudden changes not part of, and not explainable by the above pattern(s). Considered ‘disturbances’ or residual variation after the above have been accounted for. Though ‘accidental’, they can affect the nature of the other components in the	

forthcoming period(s).	

Table 1. Key components of time series data.

Referring to Table 1, the raw figures plotted against time appear irregular. We can however extract and mathematically describe a long-term trend component showing a gradual decrease followed by a gradual increase. This trend likely reflects very general but persistent factors affecting sales, such as background economic changes. We can also extract seasonal phenomena which repeat every year – our example shows that sales tend to fall to a minimum at around the middle and rise towards the end of each year. There is further evidence of cyclic movement, which are long-term irregular oscillations also indicative of background changes in the economy such as recession cycles. Finally, by subtracting all the above information (trends, seasons, and cycles) from the raw data[1], we are left with irregular fluctuations in sales figures attributable to unpredictable events (e.g. natural disasters, war), or sampling and other errors. The time series model resulting from a successful analysis will give the company insights into the structural changes underlying sales figures, and forecast them for a desired number of future time intervals.

We can conceive of discourse-related scenarios with analogous components to conceptually motivate the TSA approach. It should be noted that not every component will exist in every dataset, but scenarios in which all do exist should be conceivable. Consider for instance the case of metaphor use by a therapist-client dyad over the span of treatment. The raw data would simply be metaphor frequencies (which can be further classified into therapist vs. client, novel vs. conventional etc), most intuitively on a per-session basis. 'Background factors' analogous to

[1] This approach of differentiating and summing individual components is known as additive modeling. The alternative is multiplicative modeling where components are multiplied, which will not be discussed here.

economic changes may affect the gradual increase/decrease (trend) or cyclical changes in metaphor use over the long term. For example, an explicit 'metaphorical stance' where therapist and client elaborate a useful analogy across multiple sessions (Kopp, 1995), with increasing intensity, will introduce an upward trend. Cyclic and/or seasonal movements may be expected if therapist and client 'cycle' through a delimited range of discussion topics over time, some topics more amenable to metaphor than others. A case in point of seasonality is Boer's (1999) account of the ECONOMY IS HEALTH conceptual metaphor, found to be consistently more frequent in the winter than summer over a ten-year period. Unpredictable events which cause local 'shocks' to metaphor frequencies, analogous to natural disasters in the economic context, may also occur. Conceivable reasons include abrupt changes in the relationship dynamics (i.e. therapeutic alliance [Horvath and Luborsky, 1993]), or the sudden introduction of a topic which is particularly suited to metaphoric conceptualization. Akin to the economics example, the time series model will give therapists and discourse analysts insights into the structural changes underlying metaphor use – insights which may well complement the types of qualitative, context-sensitive analysis typical of metaphor discourse studies. Notice also that in many TSA contexts like economics, there is only one unique set or 'realization' of data since the focus is often on one company or the economy as a whole. For metaphor in psychotherapy or discourse in general, we can choose to model just one particular dyad, an averaged set of values across multiple dyads representing a common theoretical category, or a small number of qualitatively distinct dyads for comparative analysis. The latter approach is taken to address the following research questions

1. Can metaphor usage frequencies be successfully modeled with TSA?

2. How do structural interpretations afforded by TSA contribute to qualitative understanding of metaphor use (and by extension, other discourse features and contexts)?

Data and method

Transcripts of the first ten sessions of two therapist-client dyads at a Chinese university counseling center, obtained with informed consent, comprise the present dataset. They were chosen to illustrate how TSA can shed additional light on prior qualitative understanding of aspects of their metaphor use. Each session was divided into three equal time intervals to allow the possibility of capturing intra-session structural patterns in metaphor use. There are ten sessions and hence thirty observations per dyad. The broad methodological steps include i) metaphor identification, ii) TSA using the Box-Jenkins methodology (Box and Jenkins, 1976), and iii) interpretation of findings vis-à-vis prior qualitative analysis. Examples from the data will be shown in the original Mandarin Chinese with English translation.

Metaphor identification

Metaphors were identified in two phases by two trained native Mandarin speakers[2]. In the first phase, the discourse dynamics approach (Cameron and Maslen, 2010) was used to identify metaphor vehicle terms based on contrast and transfer between basic and contextual senses. The popular *Xinhua Zidian* (New Chinese Dictionary) was used for reference. After an initial meeting to calibrate understanding, the raters independently identified metaphor vehicle terms from the

[2] This was performed for the current and other related studies as part of a larger project on psychotherapy in Chinese contexts.

first session transcript of each client. They then discussed inclusion and exclusion decisions to resolve problematic examples, repeating the process with one round of discussion every two sessions. The discourse dynamics approach was chosen over others like the MIP (Metaphor Identification Procedure) (Pragglejaz Group, 2007) and MIPVU (Metaphor Identification Procedure VU University Amsterdam) (Steen et al., 2010) since metaphor production in spontaneous talk like psychotherapy does not occur exclusively at lexical unit level (Cameron and Maslen 2010: 105). Consider Examples 1 to 3.

1. 现在都能感受到自己心里有好几个洞就是他们射的

   'I can now feel the many holes that are in my heart were shot by them'

2. 我好像给自己宣布了死刑

   'I seem to have sentenced myself to death'

3. 有一些怕的东西，怕的感觉

   'there are some frightening things, frightening feelings'

In Example 1, the underlined expressions 心里 ('in my heart'), 好几个洞 ('many holes'), and 射 ('shot') all involve separate meaning contrast and transfer between a basic sense and a more abstract contextual sense related to the speaker's emotions. Example 2 is a metaphorical simile where 好像 ('seem to') explicitly signals the metaphorical comparison between the basic sense of a death sentence and the contextual sense of an undesirable emotional state. Example 3 illustrates a caveat for metaphor identification in Mandarin, where lexical compounding is pervasive and there are many examples where individual character meanings contribute to the overall meaning of compounds in ways which seem opaque even to native speakers (Ceccagno and Basciano, 2007). In Example 3, the compound 东西, which means a general 'thing', comprises two characters with respective basic meanings of 'east' and 'west'. Another example is the compound 紧张, meaning 'anxiety', which has two characters with respective basic meanings of 'tightening' and 'expanding'. While metaphor (and metonymy) is clearly involved in the derivation of such compound meanings, Mandarin speakers are unlikely to consider the conventional senses of these compounds as involving metaphorical transfer. In addition, Xinhua Zidian only lists the conventional meanings of these compounds but not the underlying figurative processes. Such examples are therefore not considered metaphorical.

The next phase involved filtering out less relevant metaphor vehicle terms such as highly conventional nominal, verbal, and prepositional metaphors which do not seem to have clear functions in most discourse contexts (Cameron and Maslen 2010: 111). The two raters independently applied the Metaphor Analysis in Psychotherapy (MAP) model (Gelo, 2008) to identify and retain only novel metaphor vehicle terms. These are defined as metaphors with non-fixed meanings, require effort to understand, and/or derived from conventional metaphors by 'extending', 'elaboration', 'questioning', 'combining', and 'image formation'. Returning to Example 1 above, 心里 ('in my heart') is conventional since it has a fixed meaning and does not require any interpretative effort. 好几个洞 ('many holes'), 射 ('shot'), and Example 2 would then be novel. After similar rounds of discussion to resolve problematic examples, the final number of metaphor vehicle terms entering the next phase of TSA is 258 for dyad 1, and 519 for dyad 2.

Time series analysis

The variable of interest is the total number of novel metaphor vehicle terms per time period. As mentioned above, TSA involves extracting patterns from long and short-term trends and cycles, selecting candidate models for these patterns, calculating parameter estimates and refining the models with diagnostic checks, and forecasting future values in the series. Computation is supported by software (e.g. SAS, R) but the key steps of model selection and refinement rely on principled manual judgement. The brief explanation below is based on dyad 1 and illustrates only the main procedures using SAS. Interested readers may consult Bowerman and O'Connell (1987) for a more detailed explanation.

Figure 1 is the initial plot of the number of novel metaphor vehicle terms against the 30 observed time intervals. As TSA involves estimating key properties of the entire process based on just one realization, the mean and variance of the observed values ought to be constant, or stationary, over time. A visual inspection of the plot suggests that the values do fluctuate around a constant mean, with a fairly constant variance, implying that in this case there is no need for transformation procedures to induce stationarity in the series.

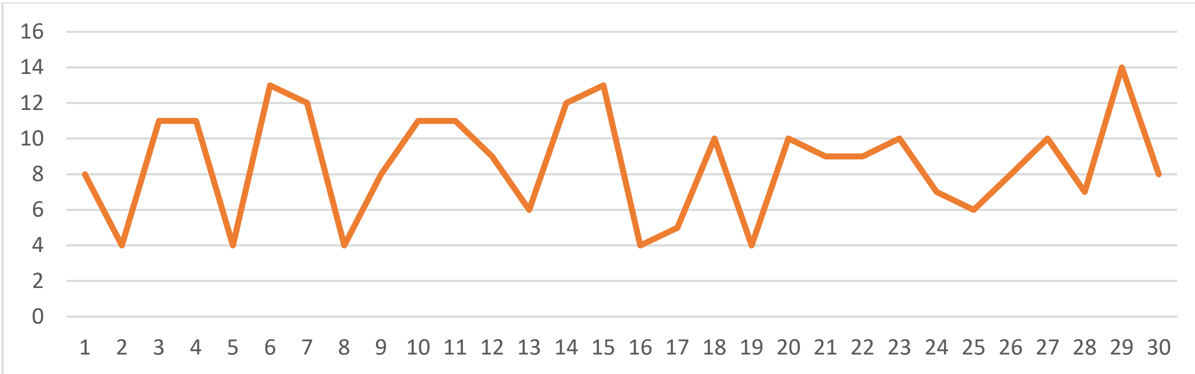


Figure 1. Plot of metaphor vehicle terms against time intervals.

The two graphs in Figure 2, also known as correlograms, are plots of the autocorrelation function (ACF) and partial autocorrelation function (PACF) of dyad 1. Autocorrelation, as the name implies, 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. Similarly, ACF at lag 2 is the correlation coefficient between pairs of metaphor frequencies at time x and time x+2, and so on. ACF at lag 0 is therefore always 1.0 since this is simply all values correlated with themselves. Generally, high positive values of ACF suggest that increases/decreases at a certain time period tend to be followed by corresponding increases/decreases, and vice versa. PACF is similar to ACF except that it measures partial correlations; i.e. 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. PACF at lag 0 is therefore always 0.0. The ACF and PACF are both crucial in revealing the nature and extent of trends, cycles, and seasons in the data. The subsequent step of model selection compares the behavior of these sample functions with the theoretical correlations expected from different models, to find the best fitting one(s) to describe metaphor use.

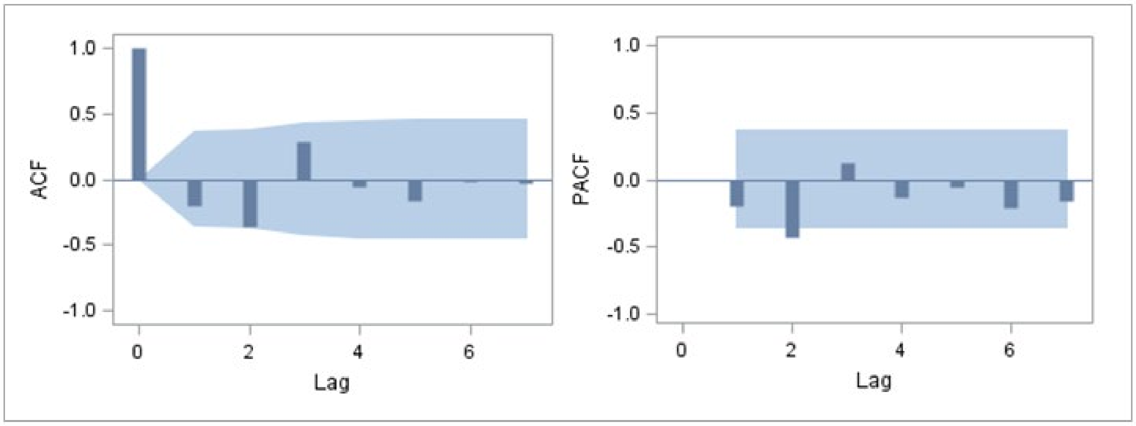


Figure 2. Plots of ACF and PACF.

The next step of candidate model selection involves judging the behavior of ACF and PACF. They either 'cut off' or 'die down', determined by whether the (P)ACF drops abruptly (cut off) or slowly (die down) to near-zero after a certain lag. The ACF and PACF tend to behave in opposite ways. If the ACF cuts off, a moving average (MA) model is more likely to fit, and if the PACF cuts off, an autoregressive (AR) model is more likely. Sometimes both may cut off or die down, in which case different models may need to be compared and/or combined. It is also necessary to specify the 'order' of the AR/MA model. This is determined by the lag at which the (P)ACF cuts off or dies down. An AR(1) model thus describes a time series with ACF cutting off after lag 1. Lastly, recurrent patterns in (P)ACF over regular lag intervals would suggest seasonality in the data. The qualitative significance of these models and their implications for understanding metaphorical discourse processes will be discussed later. In our example, both

ACF and PACF appear to cut off equally abruptly after lag 2, implying that both the AR(2) and MA(2) models are to be considered.

After the candidate model(s) are selected, the next steps are parameter estimation and diagnostic checking. Parameter estimation is performed automatically by specifying one of three methods: (un)conditional least squares and maximum likelihood, of which the latter is generally preferred (Genschel and Meeker, 2010). The two parameters of interest are the mean of the series and the value of the MA(2) operator. Following this, diagnostic checking is performed on the parameters and the residual series (i.e. the differences between actual and observed values at each time interval). The parameters should be significantly different from zero and not mutually correlated while the residuals are expected to be normally distributed and not mutually correlated. If the model fails any of these diagnostics, different candidate models may have to be selected.

Table 2. Estimated model parameters.

Parameter	**Estimate**	**Standard error**	**t-value**	**p-value**	**Lag**
Mean	8.566	0.1592	53.79	<.0001	0
MA(2)	0.721	0.1486	4.85	<.0001	2
Correlations of parameter estimates					
	Mean		MA(2)		
Mean	1.000		0.119		
MA(2)	0.119		1.000		

Table 2 (modified SAS output) shows the estimated values of the mean (8.566) and the MA operator (0.721), both significantly different from zero and hence important to the model. These parameters are also not collinear, which is important since collinearity would affect the precision of the eventual forecasts.

Figure 3) and Shapiro-Wilk statistics (W=0.974, p=0.646), while absence of correlation is assessed by checking the (P)ACF of the residual series. After this step, the model is ready to be interpreted.

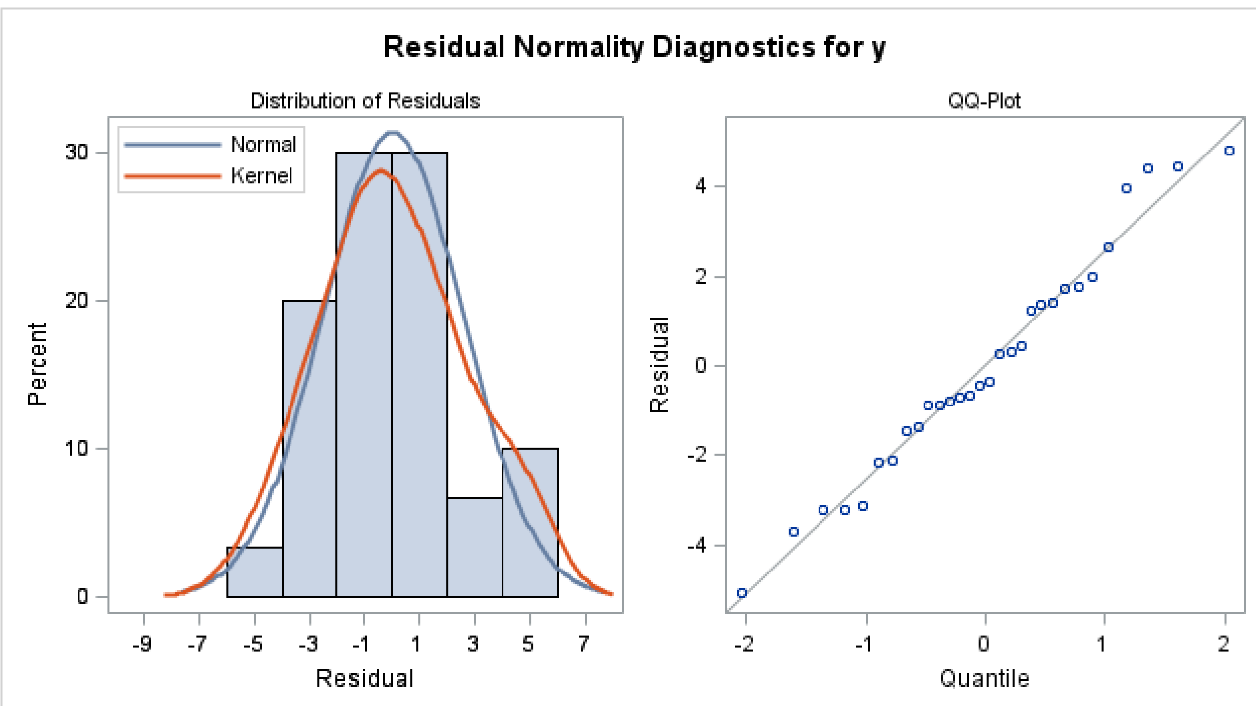


Figure 3. Normality check of residual series.

Results and discussion

Table 3 shows the actual and predicted metaphor frequencies, along with residuals and standard errors for dyad 1. Figure 4 is a plot of the actual against predicted frequencies.

Table 3. Actual and predicted metaphor frequencies (dyad 1).

Interval	Predicted	Actual	Residual	Standard error
1	8.566	8	-0.566	3.19
2	8.566	4	-4.566	3.19
3	8.834	11	2.166	2.81
4	10.732	11	0.268	2.81
5	7.24	4	-3.24	2.69
6	8.401	13	4.599	2.69
7	10.732	12	1.269	2.64
8	5.492	4	-1.492	2.64
9	7.685	8	0.316	2.61
10	9.602	11	1.398	2.61
11	8.343	11	2.658	2.6
12	7.577	9	1.424	2.6
13	6.668	6	-0.668	2.59
14	7.549	12	4.451	2.59
15	9.045	13	3.955	2.59
16	5.373	4	-1.373	2.59
17	5.722	5	-0.722	2.59
18	9.553	10	0.447	2.59
19	9.085	4	-5.085	2.59
20	8.244	10	1.756	2.59
21	12.229	9	-3.229	2.59
22	7.301	9	1.699	2.59
23	10.893	10	-0.893	2.59
24	7.341	7	-0.341	2.59
25	9.209	6	-3.209	2.59
26	8.812	8	-0.812	2.59
27	10.879	10	-0.879	2.59
28	9.151	7	-2.151	2.59
29	9.199	14	4.801	2.59
30	10.116	8	-2.116	2.59

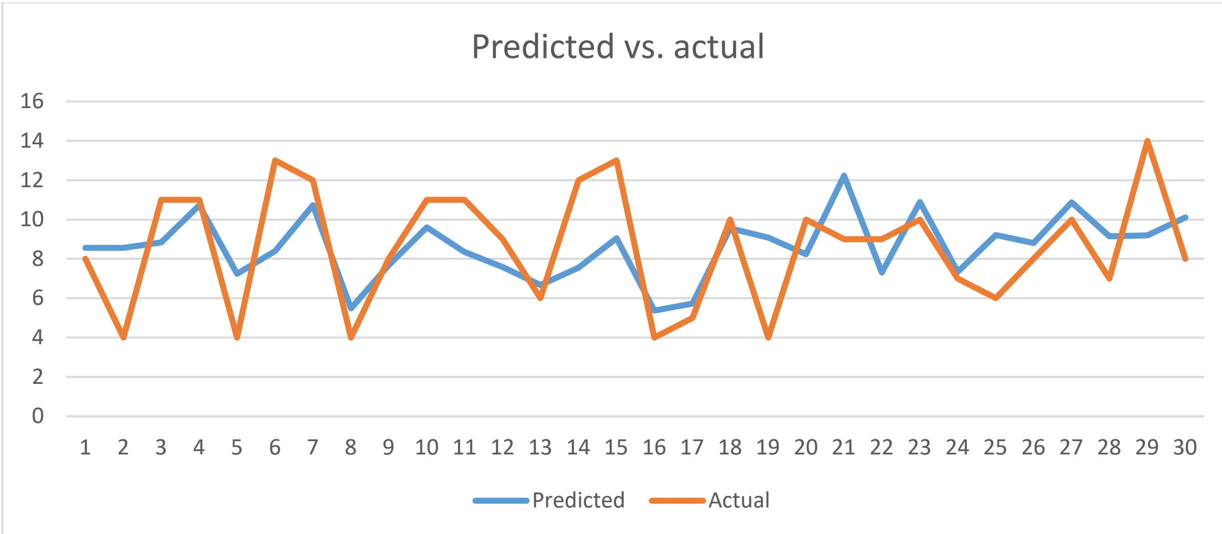


Figure 4. Plot of actual and predicted metaphor frequencies (dyad 1).

Visual inspection of Figure 4 suggests the fitted MA(2) model is reasonably accurate with mostly small residuals. We may forecast frequencies at future intervals if desired, with each additional future interval depending on prior forecasts. The forecasted frequencies for future intervals 31 to 35 are respectively 5.105, 10.901, 8.566, 8.566, and 8.566.

The model is represented by the equation $y_t = 8.566 + a_t - 0.721a_{t-2}$, where 8.566 = the estimated mean number of metaphors per interval, y_t = number of metaphors at interval t, a_t = the residual at interval t, and a_{t-2} = the residual at interval t-2. It was mentioned that the residual is the difference between the observed and predicted value, and can be understood as the unpredictable component at that particular interval.

To interpret the model in relation to qualitative understanding of metaphor use in this dyad, we can consider four of its manifest characteristics: i) whether it is an AR (autoregressive) or MA (moving average) process; ii) the order of the model; iii) the magnitude of its coefficients; and iv) the absence or presence of a constant term. Firstly, an AR process is where the present value correlates with past values, while in an MA process the present value correlates with past residuals. The fitted MA model therefore implies that the tendency to use metaphor at any interval is not as much linked to immediately prior metaphor use, than to specific prior circumstances (discursive or otherwise) which led to unpredictable increases/decreases or 'shocks' in metaphor use. Secondly, the second-order MA(2) model suggests that the effects of these shocks span at most two intervals, and thus appear to be fairly localized. Thirdly, the magnitude of the MA coefficient (0.72) suggests a fairly close correlation between the present frequency and past residuals. Lastly, the statistical significance of the constant term 8.566 suggests that there is a stable average level of metaphor use across all intervals, with departures from the average describable by situation-specific fluctuations.

The overall interpretation afforded by the fitted MA(2) model for dyad 1 can thus be summarized as follows. Therapist and client have a stable 'base average' level of metaphor use, but this usage level is modulated by specific circumstances which lead to unexpected changes in metaphor frequencies. The effect on metaphor usage of these circumstances are furthermore propagated onto not more than two subsequent intervals. How would such a structural interpretation complement the more usual qualitative discourse analytic insights into the use of metaphor in psychotherapy? TSA may for instance be performed prior to qualitative analysis, after which the nature of 'modulating circumstances' could be the subject matter of manual identification and description. It may also provide new perspectives on previously analyzed data as shown in the following dyad 1 extracts taken two intervals apart.

Extract 1

1. T: 嗯。我的心灵得到自由，同时又跟我的这个年龄可有的性的能量，满足和吸引力交织在一起 [Right. My soul is free, and it is woven together with the sexual vitality, satisfaction, and attractiveness I could have at my age]

2. C: 他们好像就是一个源泉，不断的在给我传递着，那种清新，不断的在…… [They are like a fountain, constantly passing me, that freshness, constantly….]

3. T: 哎，源泉源泉，源泉，这个词好！是不是那些不好的感觉，离我们是不是远了？[Ah, fountain, fountain, fountain, good description! Is it, those bad feelings, are they far away from us now?]

4. C: 都被冲的一干二净了，他那源泉他会散发出那种很神奇的东西，能让我那个千疮百孔的具有治疗作用，让他们慢慢的好好起来，他会散发出许多诱人的气味，草长莺飞，他会滋润我的内心，让那些本来那一片火海的东西，浇灭它 [All flushed clean. That fountain radiates something very miraculous, it can repair my damage, let them slowly heal. It radiates many tempting aromas, like a scenic end of spring, it nourishes my heart, it extinguishes what was originally a sea of fire]

5. T: 我就是那个……我们就是源泉。在这些桃花源里慢慢的流淌。滋养着这些土地，灌溉着这些植物 [I am that…we are that fountain. Slowly flowing in these peach gardens. Nourishing the land, irrigating these plants]

Dyad 1 is between a therapist and a university student experiencing trauma and severe lack of sexual confidence as a result of childhood sexual abuse by a relative. In Extract 1 we see a vivid case of a co-constructed metaphor scenario (Ferrara, 1994; Kopp and Craw, 1998) where the client's fountain metaphor (Line 2) is acknowledged by the therapist with subsequent elaboration and repetition (Lines 3 to 5). When analyzed in isolation, examples like this may convincingly illustrate how metaphors help express complex emotions and foster the therapist-client relationship (Lyddon et al., 2001), while also reflecting metaphor theoretic issues in context such as the mixing of multiple source domains (Gibbs, 2016). The more structural TSA perspective would instead highlight this sudden spurt of metaphor use as a large residual or 'random shock', in comparison with the frequencies of neighboring sessions. By deemphasizing its particularistic qualities or explicit functions, analytic attention could be redirected to uncovering the circumstances which precipitated such departures from the mean level of metaphor use (e.g. a sudden outburst of expressiveness and novelty, or the switch to a particularly sensitive topic). Furthermore, to the extent that the magnitude of this spurt is related to metaphor frequencies two intervals thereafter (i.e. the natural interpretation of the MA(2) model), the TSA analysis prompts a closer look at Extract 2 for how metaphor effects are thus propagated or 'displaced'.

Extract 2

1. T: 在宿舍里面，我穿着很长的裤子，这部分怎么样？ 试着……你是……我们是源泉，试着流到那个画面里面去 [In the hostel, I wear very long trousers. What then? Try…you are…we are the fountain, try to flow into that picture]

2. C: 他会让我在宿舍里面，我对着镜子看到，欣赏我的腿。 他会流到我的小、小鸡鸡那边，会把那些加给小鸡……小弟弟的那种负担，全部都给带走，让他迸发出青春的那种朝气和活力 [It will let me, in the hostel, I face the mirror and admire my legs. It will flow to my, my penis, it will take away all the burden given to my penis, and let it radiate the energy and vitality of youth]

3. T: 嗯，感受一下，我在展示，男性的？ [Right. Feel it. I am displaying, something masculine?]

4: C: 我在展示男性的那种，男性那种性特征，那种生殖器官的那种，所带来的那种自豪之感，喜悦之感 [I am displaying the sexuality of a man, the kind of pride and joy a man feels towards his reproductive organs]

5: T: 性特征。性自信。重复 [Sexuality. Sexual confidence. Repeat.]

Extract 2 occurs two intervals after Extract 1. In between the two extracts, the therapist has been asking the client to describe his daily activities in the student dormitory, in an attempt to understand the implications of his sexual problems on his social life. The fountain metaphor was not mentioned between the two extracts but the therapist explicitly revisits it in Line 1 by asking the client to 'flow into the picture'; i.e. imagine the therapeutic effects of the fountain in his daily life. He appears to be suggesting that the fountain can be symbolic of a renewed sense of sexual confidence (Line 5). Therefore, while TSA provides the statistical insight that present metaphor frequencies are correlated with recent past random shocks, (re)analysis of the transcript reveals important details about the qualitative nature of this relationship – in this case, it is the opportunistic revisiting of an insightful metaphor which was recently deployed on a different target topic. Manual observation and analysis could in principle lead to the same conclusions about how metaphor use across two or more intervals are related, but is unlikely to reliably reproduce similar details about how far this relationship is propagated.

To illustrate an outcome of a different nature, consider the results for dyad 2. Table 4 and Figure 5 show the actual/predicted frequencies and the respective plots. It is immediately apparent that the predicted frequency is 17.3 throughout. The equation $y_t = 17.3 + a_t$ implies that prediction is simply based on the average level plus a residual, with no significant information to be extracted from the autocorrelation of the changing frequencies. In other words, the amount of metaphor use at any particular interval is independent of other intervals. It should be emphasized that the absence of a TSA-based interpretation does not entail a corresponding absence of discourse analytic or therapeutically based interpretations. For example, a series of structurally unrelated metaphor frequencies could well be thematically related, or could in itself reflect a more spontaneous approach towards its strategic use. Regarding the first point in particular, it would be of interest to further investigate the link between structural and thematic relationships in psychotherapy and other discourse contexts.

Table 4. Actual and predicted metaphor frequencies (dyad 2).

Interval	Predicted	Actual	Residual	Standard error
1	17.3	20	2.7	5.338
2	17.3	10	-7.3	5.338
3	17.3	19	1.7	5.338
4	17.3	16	-1.3	5.338
5	17.3	16	-1.3	5.338
6	17.3	17	-0.3	5.338
7	17.3	18	0.7	5.338
8	17.3	18	0.7	5.338
9	17.3	11	-6.3	5.338
10	17.3	13	-4.3	5.338
11	17.3	17	-0.3	5.338
12	17.3	18	0.7	5.338
13	17.3	18	0.7	5.338
14	17.3	8	-9.3	5.338
15	17.3	19	1.7	5.338
16	17.3	26	8.7	5.338
17	17.3	11	-6.3	5.338
18	17.3	11	-6.3	5.338
19	17.3	16	-1.3	5.338
20	17.3	14	-3.3	5.338
21	17.3	18	0.7	5.338
22	17.3	18	0.7	5.338
23	17.3	22	4.7	5.338
24	17.3	16	-1.3	5.338
25	17.3	16	-1.3	5.338
26	17.3	10	-7.3	5.338
27	17.3	27	9.7	5.338
28	17.3	20	2.7	5.338
29	17.3	32	14.7	5.338
30	17.3	24	6.7	5.338

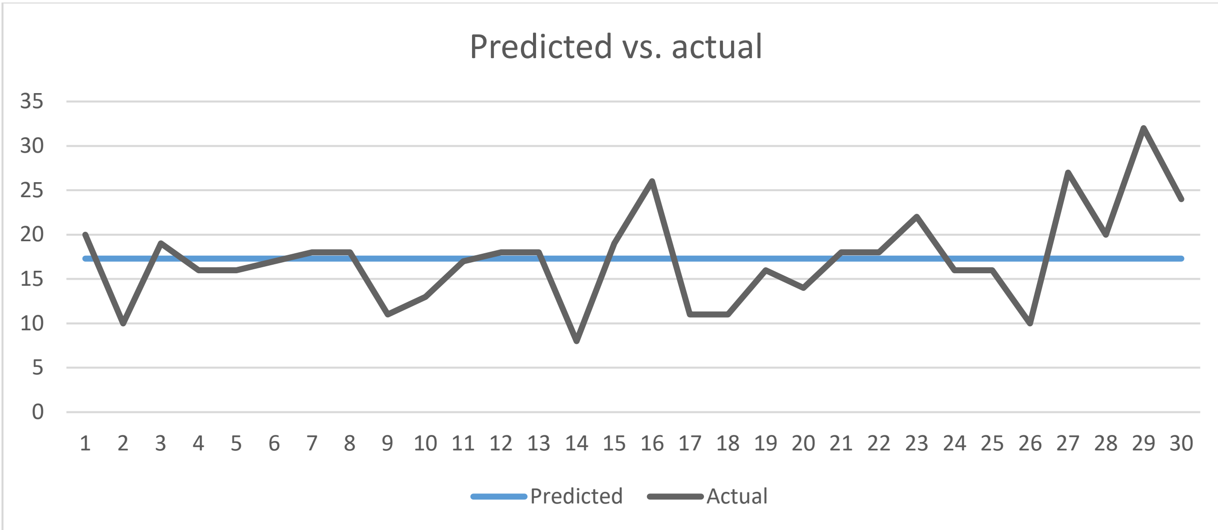


Figure 5. Plot of actual and predicted metaphor frequencies (dyad 2).

Some limitations of the present analysis and potential future directions will now be discussed. Firstly, on the specific subject matter of metaphor use in psychotherapy, future studies could separately model and compare therapist and client use of metaphors across sessions. Insights into possible structural differences between therapist and client frequencies would be relevant to the general discussion on therapist (Lankton and Lankton, 1983; Stott et al., 2010) versus client-generated metaphors (Kopp and Craw, 1998; Sims, 2003), which has tended to focus on their content and function. In order to incorporate such additional time series and explore the dynamic interactions between them, it would also be necessary to use multivariate forms of TSA such as transfer function modeling. This applies equally to the study of other discourse contexts characterized by more than one set of time series data.

The implications of forecasting as performed in the analysis of dyad 1 can also be discussed more explicitly in future work. Though important in major TSA applications, it remains less clear how forecasting generally relates to the more traditional discourse analytic goal of describing meanings and structures in context. The suggestion made earlier in the paper was that the ability to forecast metaphor use provides more information for therapists to plan interventions, but its specific applicability and rationale would likely vary across different analytical contexts. A plausible application could be to project certain linguistic trends based on past and existing usage data, contemporary social media in particular offering a productive site of investigation.

Conclusion

Time is an implicit variable underpinning many discourse contexts, but the structural characteristics of discourse phenomena across time are seldom explicitly investigated. The feasibility of TSA for analyzing discourse was presented in this paper, starting with an outline of potential discourse analogues for the time series components of trends, seasons, cycles, and irregular fluctuations. To further evaluate the descriptive accuracy and explanatory potential of TSA models, a case study was conducted with data from metaphor use by two therapist-client dyads. Each dyad was found to be adequately described by a different type of TSA process. In terms of interpretation, of particular importance is the ability to relate the structural characteristics of identified TSA models, to knowledge of the contextual circumstances surrounding metaphor use. The present approach has the potential to be replicated and extended in several ways. These include the modeling of different discourse features and contexts, examining interacting features with transfer function models, and making more explicit use of the forecasting potential of TSA to address issues of interest to discourse analysis.

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