Modeling Complex Sequences in Egocentric Relational Event Data

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Introduction

Butts's (2008) [1] *relational event framework* is ideal for modeling event histories of individual behavior occurring throughout the course of a short period of time. Under the relational event framework, we conceptualize human behavior as a set of events and seek to predict certain behaviors or patterns of behaviors from a combination of covariates and past history. Often, these patterns are at once complex and theoretically important.

Modeling complex subsequences of events in these event histories is the topic of this paper. Here, we introduce a framework for modeling subsequences of events in an event history beyond the simple K-order Markov transition from event-type to event-type. In particular, we describe statistics for theoretically important complex subsequences such as stimulus-response sequences and sequences wtih arbitrary repetition. We call our statistics *S-Forms*.

Project Goals

- Extend the Relational Events Framework to model complex subsequences in ego-centric event histories
- Define a notation for describing complex subsequences of behavior
- Build tools for operationalizing complex behavioral models
- Illustrate examples of theoretically important models

References

[1] C. T. Butts. **2008** Soc.Method. v38. pp155–200

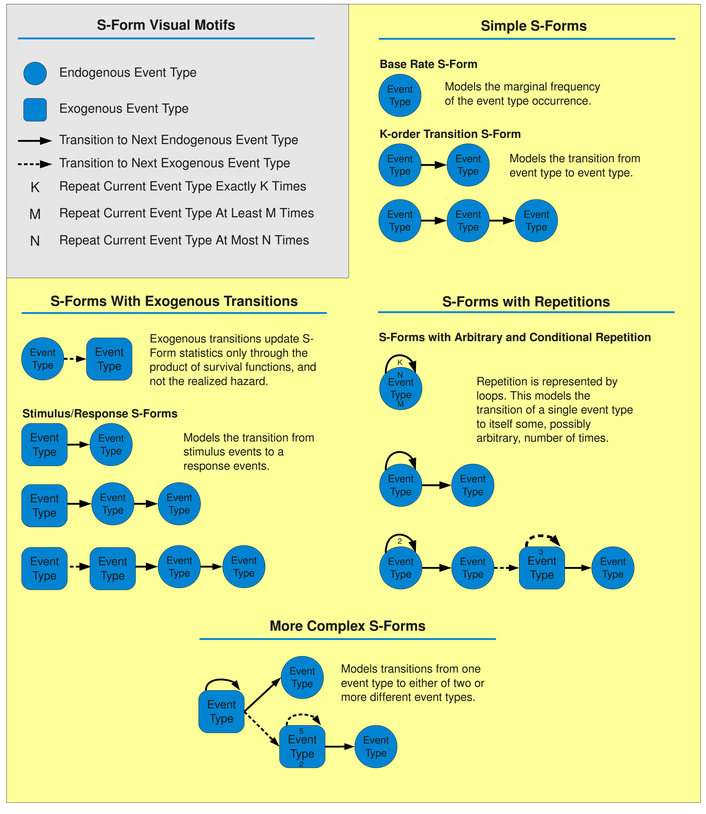
[2] A. Abbot, A. Tsay. **2000** Soc.Meth. v29. pp3–33

[3] J. Skvoretz, T. J. Fararo. **1980** Beh.Sci. v25. pp9–22

Background and Motivation

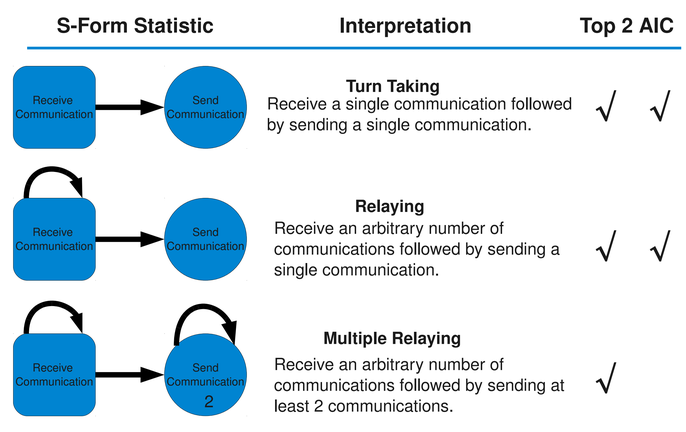
Actors often engage in one class (or type) of behavior before transitioning onto another type of behavior. These sequences may be formalized, in the case of standard operating procedures, or otherwise practical in the case of behavior-to-behavior dependence (such as starting a vehicle before driving it away). Moreover, actors often repeat the same type of behavior a fixed or arbitrary number of times before moving onto something else. Work on sequence analysis [2] and "grammar-based theories of action" [3] in the social sciences has emphasized that some behaviors tend to depend on other behaviors in fundamental ways. In nursing, for example, the standard-of-care for administering certain heart medications requires a patient's blood pressure to be taken at least three times before administering the dose. From the patient perspective, the exogenous events of getting blood pressure taken three times leads to the endogenous event of taking medication. Or, a truck driver may execute an arbitrary number of turns before parking the vehicle and dumping the payload. In this example, predicting whether the payload was delivered requires information about an unknown number of 'turning' events followed by a 'parking' event. When sequential clustering of sets of actions occurs with high probability, the resulting subsequences may be characterized *sui generis* as single units of action. We call these units *S-Form* sequences and present the following notation to model them.

S-Form Construction



Empirical Example and Results

Data come from 214 emergency responder reports of their response to the September 11, 2001 attacks on the World Trade Center and the April 19, 1995 Oklahoma City Bombing. Endogenous and exogenous actions, communications, and cognition events were coded. Egocentric relational event models of base rates for types of events plus all combinations of three stimulus-response *S-Form* statistics shown below was fit to the data. Deviance statistics from the two best fitting models favor *S-Form* statistics with either "Turn-Taking," "Relaying," and "Multiple Relaying" or only "Turn-Taking" and "Relaying" only. Results suggest that sending consecutive communications occurs in a context when actors send communication once followed by non-communication events, regardless of how often actors receive information from others.



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Scalable Methods for the Analysis of Network-Based Data