Alternative Research Methods:
MAPSAT Your Data to Prevent Aggregation Aggravation

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Overview

In traditional quantitative research methods that are based on algebraic linear models, we typically obtain *separate measures of variables*, and then we statistically analyze relations among measures (e.g., linear, curvilinear or logistic regression analysis). That is, we *relate measures*. This approach, which assumes linear and additive models, can result in aggregation aggravation—i.e., obfuscation of important relationships due to assumptions in the approach.

In traditional measurement we aggregate units when we obtain a value for a variable. For example, we aggregate (count) the number of inches when we measure a person's height, or we count the number of years when we measure someone's age. We repeat this process of *independent* aggregations for more persons' heights and ages. Then we attempt to do a statistical analysis of these sets of independent measures, such as correlation or linear regression. This kind of thinking stems from algebra—e.g., $y = Bx + C$, where variable y is measured separately from variable x, and a *functional relationship is assumed* to exist between x and y, where B is the slope and C is a constant.

Alternatively, we could *measure relations* directly. This is not a play on words, but a significant paradigm change in conceptualizing educational research problems and how we collect and analyze data: *map relations* instead of *measuring variables*, and then *analyze relation maps* instead of *statistically associating variables*. We call this alternative approach MAPSAT: Map & Analyze Patterns & Structures Across Time. MAPSAT is a *logical* analysis of relations, not a statistical analysis of separate measures. In MAPSAT, there are two approaches that can be taken. In the *Analysis of Patterns in Time* (APT) approach, we map temporal relations. In the *Analysis of Patterns in Configuration* (APC) approach, we construct a map of *affect-relations* in a system.

MAPSAT is a form of network measurement and analysis. More specifically, Dynamic Bayesian Network Analysis (DBNA) and Social Network Analysis (SNA) are similar to MAPSAT in that they are types of network analysis and are grounded in mathematical digraph theory (Thompson, 2008; Jensen & Nielsen, 2007; Brandes & Erlebach, 2005). These three approaches to network analysis are more closely related, compared with extant methods of measurement and regression analysis described above. While MAPSAT APC methods and SNA do have common aims, the advantages of MAPSAT are its theory basis (ATIS: Thompson, 2006b; 2008) and ability to measure structural properties of hypergraphs of multiple sets of affect-relations. Moreover, MAPSAT APT methods differ from DBNA in that Bayes Theorem is not assumed nor used in computing conditional probabilities in APT; rather relative frequencies of temporal sequences determine APT conditional probabilities.

Examples of APT

Frick (1990) invented a procedure called Analysis of Patterns in Time (APT) in order to map temporal relations. Phenomena are observed and coded with categories in classifications. The resulting temporal maps are then queried for temporal sequences of events. For example, Frick (1990) created temporal maps of student engagement and interactive instruction and found that, when interactive instruction was occurring, the temporal likelihood of student engagement was very high (0.97). However, when non-interactive instruction was occurring, then the probability of student engagement was much less (0.57). Regression analysis of the same data (when engagement and interactive instruction were aggregated separately) was only able to predict 32 percent of the variance in student engagement—i.e. aggregation aggravation.

Frick, Chadha, Watson and Zlatkovska (2008) used APT in a study of teaching and learning quality in postsecondary education. Based on student course evaluations (n = 464 in 12 different courses), they found that when students agreed that First Principles of Instruction occurred in their courses (Merrill, 2002) *and* they also agreed that Academic Learning Time occurred (ALT: Berliner, 1990; Rangel & Berliner, 2007), students were about 5 times more likely to be rated at a High Mastery Level by their course instructors than they were when they did not agree that First Principles and ALT occurred. Even more significant, students were about 26 times more likely to be rated at a Low Mastery Level by their instructors when students did *not* agree vs. agree that both First Principles and ALT occurred. When linear regression analysis of separate measures of these variables was attempted, there was no clear or strong linear relationship between First Principles, ALT and student Mastery. Less than 10 percent of the

variance in student Mastery was predictable—i.e. aggregation aggravation. On the other hand, the triadic patterns were clear in the APT analysis.

An example of APC

Thompson (2006a, 2006b; 2008) has developed Axiomatic Theories of Intentional Systems (ATIS). ATIS Graph Theory provides a way to measure 17 structural properties of systems that include strongness, flexibility, interdependence, wholeness and vulnerability. This approach is called Analysis of Patterns in Configurations (APC).

A study of a Montessori classroom indicated that some structural properties were markedly different in two different types of learning settings: head problems and morning work period. In the latter, for example, there was much more *interdependence* with respect to affect-relation sets for *choice of learning activities* and *guidance of learning* (Koh & Frick, 2007).

Further studies that utilize MAPSAT methods

We describe below three new studies that employ MAPSAT APT methods. The first is a study of patterns of feedback when students are anonymous or not when critiquing each other's work during an asynchronous discussion in an undergraduate course for preservice teachers. The second is a study of the relationships between comments students receive from other students during asynchronous discussion, and the quality of the work they offer up for discussion. The third study shows how MAPSAT was used to analyze sequences of game player moves in the online Diffusion Simulation Game. These studies further illustrate the value of using MAPSAT methods to prevent 'aggregation aggravation'.

Study 1: Anonymity to Promote Peer Feedback

Problem. Present-day tools such as Learning Management Systems (LMS) provide teachers with options to make learner-learner communication anonymous (Dreher & Maurer, 2006; Lin, Liu, & Yuan, 2001; Zhang & Zhao, 2008; Zhao, 1998). By eliminating social influence, group pressure, status and power differentials, computer-mediated communication (CMC) has been credited with bridging social boundaries (Rheingold, 2000; Walther, 1996; Warschauer, 2004). However, the nature of CMC introduces possible negative consequences of using these affordances as educational tools. Anonymity in CMC poses the risk of learners acting less like individuals, and more like an uninhibited, unfriendly, and curt group—the social identity de-individuation effect, SIDE (Postmes, Spears, & Lea, 1998; Postmes, Spears, Sakhel, & de Groot, 2001). By combining MAPSAT analysis with computer-mediated discourse codes (Herring, 2004) research questions surrounding the pedagogical decision on whether or not to include anonymity, specifically psuedonymity or type 5 anonymity (Flinn & Maurer, 1995; Pfitzmann & Köhntopp, 2001) in peer feedback activities asked (1) to what extent does anonymity promote or deter students from providing constructive feedback, (2) how students' comments change when anonymous, and (3) what prescriptions can be made for teachers who use wikis and anonymous configurations in education via CMC?

Method. The learners were university education majors at Indiana University in Bloomington. The LMS was an instantiation of SAKAI. Fifty minute feedback sessions were held where the asynchronous feedback platform, a wiki, could be used simultaneously by an entire class. The study used the second of two critiques held in a course. Students posted a link to their website within their own wiki, and class members viewed and posted comments about the website design directly onto the target students' wiki. No directions about the substance of comments were given. Seventy-nine of 85 students agreed to have their work included in this study. Thirty-seven (class sizes 22 and 15) students made up the two anonymous classes where 35 of these students agreed to participate. Forty-eight students (9, 20 and 19) made up the classes where both interlocutors' names were visible. In this group, 37 agreed to participate.

Learners' online comments were broken into utterances of semantic meaning into four categories to identify the substance of utterances. The mutually exclusive codes were *constructive*, *reactionary*, *clarifying a standard* and *other*. The utterances were also coded for tone—*positive, negative* or *neutral*. Each utterance received then two codes, creating joint occurrences of the two categories. In order to get a more holistic descriptive statistic of the students' participation in the critique, without discriminating for style, a *critical feedback* measure of both implicit and explicit suggestions aggregated negative reactions with constructive utterances. An inter-rater agreement test was performed which met the requirements set forth in Fraenkel and Wallen (2006). Learner

behavior *in sequence* was investigated to determine which group, the anonymous or the known identity, had the highest frequency of patterns resulting in critical feedback.

Results. Between the anonymous and known identity groups, the mean number of comments was not significantly different, but the mean number of words and utterances written was significantly different. Anonymous participants wrote significantly more words ($p < .05$) and utterances ($p < .01$). On average per student, 71 more words and 9.5 more utterances were written over the course of the task under conditions of anonymity. Not all participants in the anonymous group wrote more than those in the known identity group. In fact, anonymous participants whose number of words written was one standard deviation below the mean wrote less than half as many words as known identity participants whose number of words written was one standard deviation above the mean. However, the patterns of the utterance types were more revealing of the differences between the conditions.

We limited our analysis of patterns to sequences of utterances leading to critical feedback, the heart of the pedagogical intervention—namely *negative reactions followed by a design alternative or suggestion*, or *positive reactions followed by critical feedback*. Some critical feedback fit neither pattern—for example, critical feedback beginning a comment. Keeping in mind that the anonymous groups had a higher percentage of critical feedback overall, means of frequencies per comment of both patterns showed significant differences between the two conditions (see table 1). The frequency of the positive reactions followed by critical feedback pattern was significantly higher ($p < .05$) in the anonymous group as was the pattern of a negative reaction followed by a design alternative or suggestion ($p < .01$). Anonymous commenters produced 10% more occurrences of the *positive reaction then critical feedback* pattern, and more than four times as many *negative reactions followed by a design alternative or suggestion* patterns than the known identity group. Thus, in the anonymous condition in these critiques, students were between 4 and 5 times more likely to provide reasons or at least negative reactions before their constructive criticism, and more likely to couch their critical feedback when they did not precede it with a reason for change.

Table 1. ***Comment pattern rates per student per comment by group***

Comment Pattern (Relative frequency perer Student per Comment)	Anonymous Group (n = 35)		Known Identity Group (n = 37)		Equality of Means (2-tailed t-test)	
	M	*SD*	*M*	*SD*	*t*	*df*
Positive Reactions *then* Critical Feedback	.444	.215	.339	.221	2.049*	70
Negative Reaction *then* Constructive Utterance	.10	.10	.02	.05	3.79**	49

* $p < .05$ ** $p < .01$

Discussion. This APT study suggests that not only does anonymity promote, rather than deter students from providing constructive feedback, but it also increases the meaningful part of the intervention, suggesting changes based on reasons. Meaningful engagement, including meaningful online interactions, are key elements for young designers to enter communities of practice (Schwier, Campbell, & Kenny, 2004).The SIDE theory's prediction that anonymous interlocutors would be less inhibited seems to be evident, while a negative consequence, curt utterances, were only found in an extreme outlier. Students' comments became less inhibited, however not unjustified or random. As a pedagogical prescription, we can see a basis for suggesting type 5 anonymous, pseudonymous, critiques as an introduction to basic feedback skills, keeping in mind that the condition of anonymity ignores differences between learners which might warrant unique feedback for individuals. The lower number of purely positive reactions in the anonymous groups suggests they needed to spend less time on typing out compliments and spent more time on giving suggestions. A greater amount of time exploring design alternatives and a lesser amount of time devoted to simple politeness may be a more efficient use of time spent on feedback, for both the giver and the receiver. An anonymous introduction to online feedback may provide a less stressful route to developing feedback skills in novice learners.

Study 2: Validity of Computer-mediated Formative Peer Assessment: Pre-service Teacher's Comments in Asynchronous CMC

Purpose. The purpose of this study was to compare the patterns of pre-service teachers' online comments about peer websites with instructor ratings of the same websites. Computer-mediated formative assessment by peers has specific pedagogical benefits in the context of pre-service teacher technology education. Experience with formative assessment by peers prepares pre-service teachers to be digital-age instructors, generates more feedback quickly and provides for more socio-culturally enriched contexts.

Theoretical framework. Our understanding of peer assessment is based on Topping's definition that peer assessment is "an arrangement in which individuals consider the amount, level, value, worth, quality, or success of the products or outcomes of learning of peers of similar status" and it promotes "cognition and metacognition, affect, social and transferable skills, and systemic benefits" (1998, p. 197). Peer assessment can have a qualitative/formative orientation (as in this study), quantitative/summative orientation, or both. The systemic benefits that Topping refers to include reducing the assessment burden that instructors face.

Research questions. We also needed to be aware of our understanding of the task being assessed by the learners. Learners were conducting formative assessment on assignments that attempt to address a complex and multi-dimensional problem: designing a website for learning. The challenge of designing an instructional website is one example of the complex (Reigeluth, 2009) or even wicked (Mishra & Koehler, 2006) problem of enhancing learning experiences with technology. Thus we conceptualized the study as an investigation of how formative assessment by peers does or does not align with summative expert ratings, and how learners choose to structure their discourse with peers.

Method. Five intact sections (n=71) of a pre-service teachers' educational technology course in 2008 at the Indiana University Bloomington School of Education produced two types of data for this study: (a) rudimentary instructional websites, and (b) comments about those websites given by peers. These data came from the same online activity described earlier in the anonymity study. Differences in number of participants in the present study were due to use of further data on the quality of student websites according to instructor ratings. Several student website assignments could no longer be accessed during data analysis phase of this study and the associated students subsequently had to be dropped from the current study.

Researchers created a rubric based on the assignment guidelines and summatively rated student websites as poor, fair, or excellent. Researchers individually rated each student's website, compared ratings, and then achieved consensus on the rating. Analysis done in the anonymity study described earlier generated data about student online comments about peer websites. Recall that in the anonymity study each online comment had been broken into utterances of semantic meaning using computer-mediated discourse analysis guidelines and quantified in terms of substance, tone, and number of words (Herring, 2001, 2004). The utterance data was then analyzed to find the frequency of specific utterance patterns associated with specific website ratings through the application of MAPSAT pattern analysis methods (Frick, 1990).

Results. The following focuses on one portion of the results associated with the MAPSAT analysis. Pearson correlations were calculated between researcher website ratings and the frequencies of two specific utterance patterns: (1) positive reaction utterance followed by a constructive utterance; (2) negative reaction utterance followed by a constructive utterance. Unlike utterance pattern one, the frequency of the utterance pattern two had a significant negative correlation with the instructor website rating, r=-0.409, n=71, p<0.0005.

Discussion. The results of MAPSAT analysis suggest a possible issue with the use of formative peer assessment that would be difficult to detect with other methods. Pattern one begins with a positive reaction that may lessen the negative emotional impact of the constructive utterance. Pattern two makes no attempt to soften the possible negative emotional impact of the constructive utterance. Pattern two is harsher than pattern one since it starts with a negative reaction instead of a positive reaction. The results show that the lower the website rating the higher the frequency of the harsher pattern two. The affective or emotional impacts of receiving overly negative or harsh feedback from peers on learning are not well understood (Picard et al., 2004) but teacher feedback patterns, such as the "feedback sandwich" (Eckstein et al., 2002), exist to reduce the negative emotional impact of providing too much critical feedback. Those with poor quality websites did not receive significantly more critical feedback that was couched with a positive reaction than did those with higher quality websites. This finding suggests that the preservice teachers in this study were harsh since they did not encourage poorer performing learners as an experienced teacher might.

Conclusions. MAPSAT analysis enabled the researchers to analyze the structure of student comments in a way that accounts for the temporal dimension. In the context of formative peer assessment, *what is written when*

matters. This study found significant correlations between specific patterns of pre-service teachers' online comments about peer websites and instructor ratings of the same websites.

This study has important implications for both teacher educators and educational technology researchers. Most Schools of Education devote at least one course to the topic of educational technology (Moursund, 1999) and consequently there is a need to provide pre-service teachers with sufficient formative feedback on the digital artifacts that they create during these classes. Distributing the task of providing feedback to students may enable technology-savvy peers to provide feedback that instructors may not be able to give due to time constraints-. In addition, lack of sufficient and timely feedback in online classes may contribute to the disconnected feeling that many students experience in online classes (Ko & Rossen, 2001). Peer assessment could help to mitigate feelings of disconnection by providing increased opportunities for both receiving timely feedback and for engaging with classmates.

Future research could focus on what patterns of feedback align with guidelines regarding what type of feedback has the most impact on learning (Shute, 2008) or on the relationship between the feedback that a student creates and the quality of the products they create.

Study 3: An Analysis of Patterns of Gameplay Data in the Diffusion Simulation Game

This study describes how the MAPSAT method Analysis of Patterns in Time (APT) was used to analyze gameplay data from the online Diffusion Simulation Game (DSG). The DSG was originally developed as a board game by Dr. Michael Molenda and Patricia Young in 1976 to help Instructional Systems Technology graduate students at Indiana University learn the theory of *diffusion of innovations*. An online version of the DSG was developed in 2002 for use in the department's growing distance education program. The use of APT to analyze the data led to interesting findings that would not have been revealed using traditional statistical methods. These findings include differences between the strategies used by expert and non-expert players as indicated by the most common sequences of activities selected, as well as the most common joint occurrences of individual staff members selected to engage in particular activities.

Statement of the problem. Fidelity is the degree to which a simulation is faithful to that which it simulates. While high fidelity may seem desirable, several researchers have found that it is not always necessary and may in fact deter learning (Alessi & Trollip, 2000; Feinstein & Cannon, 2002; Winn, 2002). Reigeluth and Schwartz (1989) theorized that the most fundamental aspects of a simulation should have high fidelity, while lower fidelity is appropriate for the more superficial aspects that may otherwise lead to cognitive overload and impede learning and transfer.

In the DSG, the strategies used are the most fundamental concepts needed for learners to understand how to take on the role of a change agent effectively. However, the strategies that have been successful in the game have never been assessed in terms of their fidelity to the strategies predicted to be effective by the theory of the diffusion of innovations.

The theory of diffusion of innovations attempts to explain how innovations are adopted by a group of people (Rogers, 2003). The theory offers strategies that a can be used by a change agent—a person or group that wishes to promote the adoption of an innovation—in order to increase the probability that the innovation will be adopted as well as to speed up the adoption process. The purpose of this study was to examine the fidelity of the DSG to the theory of innovations by determining whether the strategies that are successful in the DSG are congruent with the strategies that the theory would predict to be effective.

What is the Diffusion Simulation Game (DSG)? The DSG is a simulation game in which a player takes on the role of a change agent in a junior high school. The main learning goal of the game is the comprehension of the theory of the diffusion of innovations first proposed by Rogers in 1962. The player's objective in the game is to persuade as many of the 22 staff members as possible to adopt an innovation–peer tutoring. To be effective, players must learn appropriate application and sequencing of the available diffusion strategies.

The primary game mechanic of the DSG is the selection of diffusion activities that the player, as the change agent, can choose in order to persuade staff members to become adopters of the innovation. The diffusion activities (Talk to, Ask Help, Pilot Test, Site Visit, Print, Presentation, Demonstration, Self-administered Workshop, Professional Workshop, Workshop to Develop Materials, Local Mass Media, Compulsion, and Confrontation) each cost the change agent a different number of weeks to complete and have varying impact on staff at different times in the game. With only a two-year calendar for the change agent to complete the diffusion process, selecting the most efficient diffusion activities at the appropriate points in the game is crucial to winning the game.

Players also have access to information on individual staff members and diagrams of the interpersonal communication channels that exist (lunch mates, committees, and social networks). This information can be used to

determine which staff members to include in the selected diffusion activities. While some staff members are well connected and influential, others are not. Therefore, the selection of staff for the activities is as important in the strategy of the game as the selection of activity.

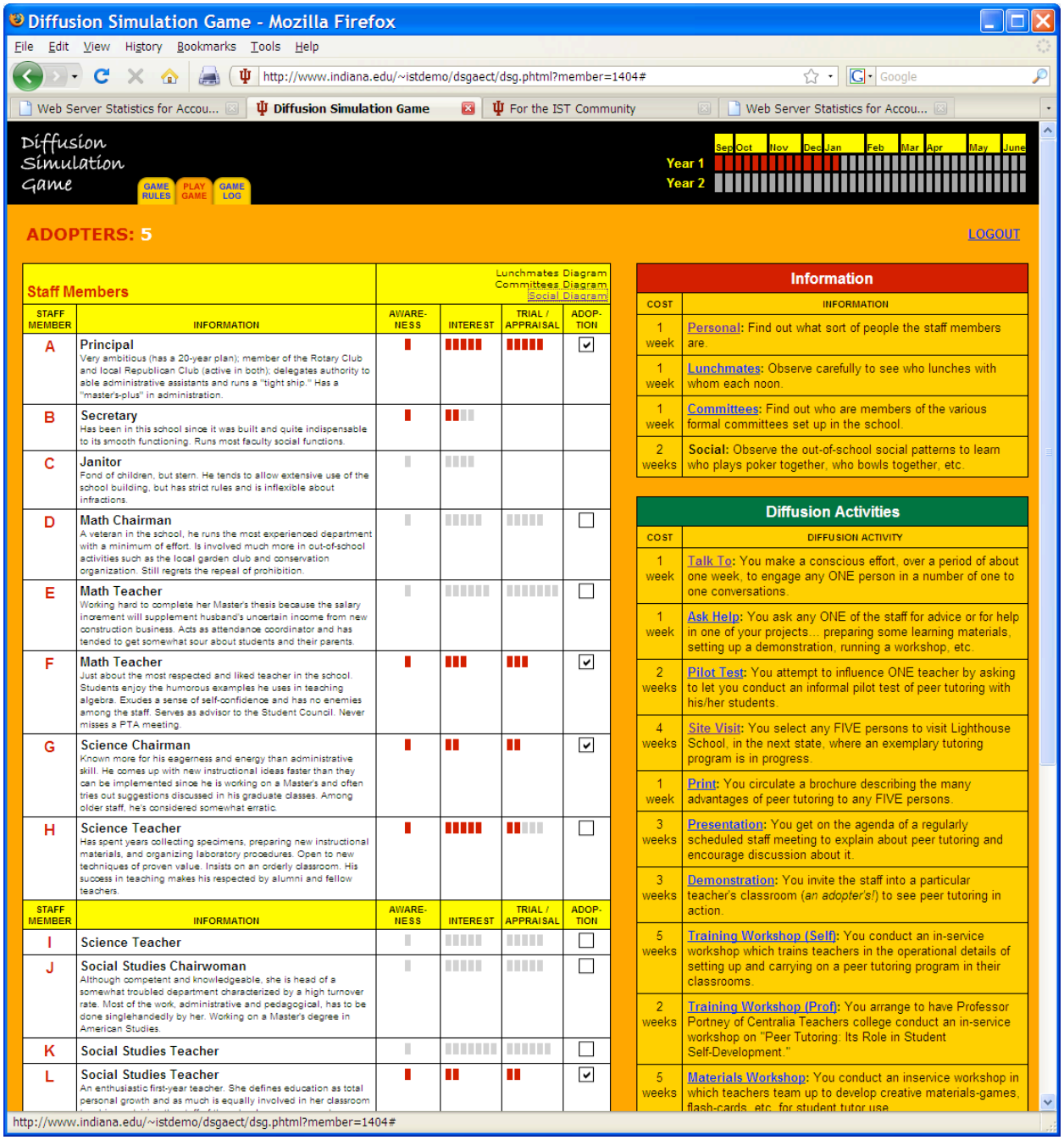

Figure 1. Screen capture of the Diffusion Simulation Game (v1) in progress.

To get staff members to become adopters, the player must progress the staff members through the adoption phases of *awareness*, *interest*, and *trial*. For each staff member, a variable number of boxes exist for each of these phases that represent how far along the staff member is in the innovation decision process. All staff members have one box that must first be filled in the awareness phase, two to seven boxes in the interest phase, and two to seven boxes in the trial phase. The number of boxes can give players insight as to what *adopter type* each staff member is: *innovator, early adopter, early majority, late majority, or laggard*.

Research questions. As previously stated, the purpose of this study was to examine the fidelity of the DSG to the theory of the diffusion of innovations by determining whether the strategies that are successful in the DSG are congruent with the strategies that the theory would predict to be effective. Specifically, the researchers attempted to answer the following questions:

1. What strategies were successful in the game sessions being studied?
2. Are the strategies that are successful within the game aligned with strategies that would be predicted by the theory of the diffusion of innovations?
3. Do other successful game strategies exist that do not relate to the theory of the diffusion of innovations?

Data collection. Due to a growing interest in the game outside of Indiana University, a free, limited version was developed in 2006 which required no university login. The data from this study was generated from the first 10,000 game sessions of the free version occurring between Oct. 7, 2006 and April 4, 2009. Of the 10,000 game sessions, almost half (4,489 games) ended with the player never selecting a diffusion strategy. The player simply did not attempt to play the game. The data set was further narrowed down to the game sessions that would give enough information about what strategies, if any, were being used throughout the *entire* game. Therefore the final data set used for the study consisted of 2,361 *finished games*—all game play sessions in which players completed all 72 weeks or won the game by convincing all 22 staff members to adopt the innovation. The sample of players was unknown as anybody with Internet access may have played the game. However—given how knowledge of the game was spread, communication from those using the game, and IP address/login information— it is likely that many players were students outside of Indiana University who were learning about the diffusion of innovations in an educational setting.

Data analysis and results. The data set was divided into three categories to be used as a means of comparing strategies used in the game. *Successful strategies* represented the 341 game sessions in which the player got 100% of the 22 staff members to adopt the innovation. Though all of these strategies led to triumph, the efficiency of how quickly players won the game varied greatly. While some players needed all 72 weeks of the game to win, others needed fewer than 40. The next category consisted of the 488 games in which 16 to 21 adopters were gained. Due to an element of randomness designed into the DSG, these strategies may have been successful or unsuccessful. *Unsuccessful strategies* represented the remaining 1,532 games in which fewer than 16 staff members became adopters.

Not only was there summative information on each of the 2,361 finished games, information for each of the 107,294 turns taken within games was available. Descriptive and inferential statistics were used to understand the data using each game session as the unit of analysis. Space precludes a detailed discussion of the results. Therefore, it must suffice to say that for the eight strategies examined, which were inferred from the diffusion of innovations theory, *t*-tests found statistically significant differences between games with successful strategies and games with unsuccessful strategies for seven of the identified strategies. This is not surprising given the large sample size (Enfield, Myers, & Lara, 2009). However, to answer the research questions of the study, analysis of the strategies within each game was needed. APT provided methods for analyzing both the sequences of activities selected and the joint occurrences of individual staff members and activities selected within games.

To understand which sequences of activities were used within games, a frequency count for every sequence of activities occurring in the data for combinations of 2, 3, and 4 turns was calculated. The analysis of sequences led to the discovery of strategies that could not have been found using inferential statistics. For instance, the most common sequence of four activities in games with successful strategies was the use of the *print* activity four times in a row, while in games with poor strategies it was the use of the *talk to* activity four times in a row. Furthermore, APT also provided methods for looking at the joint occurrences of the activities selected and the staff members selected for each activity. In games with successful strategies, the *print* activity was 3.8 times more likely to be used with the principal, 3.3 times more likely to be used with opinion leaders, and 3.5 times more likely to be used with highly connected staff members (those with connections to 10 or more other staff members) than in games with poor strategies; these targeting strategies are predicted by Rogers' theory to be successful. In examining these joint occurrences it becomes clear that successful strategies utilize communication channels (the *print* and *local mass media* activities) with influential stakeholders (the principal, opinion leaders, and staff members with large social networks).

Summary

These three empirical studies have illustrated the value of a MAPSAT approach to analysis of relations. Relations were viewed as temporal patterns in these studies. Instead of aggregating values for each unit of analysis separately and then using a linear model to study the relationships among variables, patterns *within* each unit of analysis were identified and counted. Thus, the "measure" of a variable was derived by counting instances of a pattern or relation itself within each case (unit of analysis).

For example, in Study 1, a pattern was identified: an utterance which was a negative reaction to a peer's website, *followed by* an utterance that was a constructive comment (e.g., Yuk! Hard to read. [negative reaction] You need greater contrast between text and the background to improve legibility [constructive comment]). For each student (the unit of analysis), this pattern was aggregated so that a rate of occurrences of such an utterance pattern per comment made by that student could be calculated. Thus, the pattern rate was the measure which became the value of the variable (negative reaction *then* constructive utterance). The variable was conceived as a pattern within the conceptual framework of the research. Then these variable values were averaged across students within each group (anonymous vs. known identity) and a standard parametric statistical procedure was used to compare groups (a *t*-test here).

What is important to note, however, is that if these utterance types were aggregated separately, where one variable is 'negative reaction utterance' and the other variable is 'constructive comment utterance', then we would have *two* variables not one. The only way to look at the relation between those two variables, when aggregated separately, is some kind of statistical correlation or covariance analysis. This can obfuscate the actual temporal relation. In fact, it is mathematically impossible to determine joint or sequential frequencies when only marginal distributions are known, except when relations are deterministic (cf. Frick, 1990). This is what is meant by "aggregation aggravation." If data are collected such that the patterns are preserved, then temporal or structural mapping can subsequently be done as "measures" the values of variables. If not, then MAPSAT cannot be done at all, or can only be done in a limited fashion as in Frick et al. (2008). Like Humpty Dumpty who fell off the wall and broke into pieces, the relationships among the pieces when Humpty Dumpty was whole are lost. Thus, advance planning of studies so that MAPSAT methods can be used is paramount.

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