Institutional Communication Dynamics in Instructional Effectiveness: Development of a Student Self-Report Measure of FVP, LMX, and TMX in a Pedagogical Context

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ABSTRACT

Fractal vertical polarization (FVP) has joined leader-member exchange (LMX) and team member exchange (TMX) as one of the available models of communication dynamics based on complexity theory, which now all benefit from valid scales for use in organizational settings. The purpose of these models is to assess the quality of interpersonal information flow, which affects such outcomes as motivation and trust. High levels of FVP, or contrarily low levels of LMX or TMX, may obstruct communication flow and consequently interfere with people's ability to function at the peak of their capacities. This paper begins the process of developing self-report measures of these constructs in generalized form for student use in the context of instructional evaluation. The premise is that obstructions in communication flow at the institutional level in education may hamper student learning in the same way that these conditions obstruct motivation in productive enterprises. The result of the factor analysis presented herein is a usable set of scales, construable as student-perceived FVP, student-perceived generalized LMX, and student-perceived generalized TMX. The paper presents correlations with selected variables of interest, and concludes with recommendations for future research in this area.

INTRODUCTION

Of the many forces that affect students' ability to learn in the college setting, the quality of the flow of communication in the educational institution merits some exploration. For example, students may experience problems in trying to navigate school requirements due to confusion over where to find the requisite information (e.g., due to inadequately organized websites). This confusion may undermine their ability to learn in the classroom, either by injecting a feeling of futility into their relationship with the institution or by indirectly communicating to them a lower set of expectations that those that the institution actually intends. The point is that the context of the student's relationship with the institution, which implicates institutional trust and loyalty, may hold students back in ways that have yet to become apparent in educational research.

Accordingly, the present study seeks to apply three theoretical constructs based in complexity theory to the educational setting. These constructs consist of fractal vertical polarization, generalized leader-member exchange, and generalized team-member exchange, or FVP, gener-

alized LMX, and generalized TMX, respectively. FVP refers to dysfunctions or obstructions in communication flow patterns generally along the vertical axis in organizations (Voss & Krumwiede, 2012). LMX similarly attends to the vertical axis, but the model instead looks for high quality (i.e., open, vibrant, and meaning interaction between leaders and subordinates) in this information flow (Graen & Cashman, 1975). Lastly, TMX looks at horizontal flows, again seeking high quality in their enactment (Seers, 1989). Of these constructs, LMX and TMX have an established history in organizational research, while FVP is a newer adjunct to the available theories based in complexity theory.

Historically, LMX and TMX have limited their scope to the immediate unit of analysis. Hence, the standard LMX questionnaire asks respondents to reveal information about communication flow patterns with their immediate supervisors. Similarly, the standard TMX questionnaire asks respondents to reveal information about their coworkers in a team context. FVP, by comparison, is a generalized construct, because its application seeks to enable respondents to reveal insights about the organizational communication flow in general, throughout the organization, rather than limiting that view to the immediate unit of analysis. Given the purpose of this study, to develop a self-report instrument that enables students to reveal insights about their institution as a whole, this study presents generalized construals of LMX and TMX as well, based on the recent work of Voss, Krumwiede, Lucas, and Fedorovich (2014).

LITERATURE REVIEW

Fractal vertical polarization consists of three ideas, each of which has meaning in the context of complexity theory, which is the antecedent paradigm of this theory (Voss & Krumwiede, 2009, 2010; Voss, Krumwiede, & Duncan, 2010). The element of polarization forms its basis, as early research into open or complex systems revealed a relationship between power asymmetries and obstructions in the flow of information (cf. Esteban & Ray, 1994; Tedeschi, 1968). The reference to vertical power asymmetries, as opposed to asymmetries along other possible communication axes, focused on the interaction between legitimate sources of organizational power and personal sources of power (French & Raven, 1959). To date, vertical lines of communication have constituted the main thrust of research into organizational polarization.

The fractal property referenced in the construct's nomenclature refers to the observation that one of the most regular characteristics of complex systems is their nature as self-replicating structures. Specifically, as any system in this paradigm grows over time, its basic structure, such as the relative spacing between branches on a tree, replicates to form a larger structure that is self-similar on the dimension of scale, based on the same elemental structure (Chatterjee & Yilmaz, 1992; Chua, 2005). The concept of fractality began with Mandelbrot (1967, 1977), who originally called it a fractional property, emphasizing the consistent fraction of scale at which each level of analysis reveals the elemental structure anew. While it is easiest to point out fractality in a tree, given the similarity of proportional spacing that one observes among branches, then among the sprigs that sprout from those branches, and finally among the leaves that sprout from those sprigs, the property is visible in dynamic complex systems as well, such as organizations. In this case, the object of analysis is a cyclical event, rather than a physically static aspect of structure, which one could perceive easily (Katz & Kahn, 1978). Its abstraction makes it harder to analyze than a tree; nevertheless, the regularity of its elemental structure is indeed discernible with patience and an occasional epiphany. Regardless of the complex system at issue, studies of fractality require a qualitative examination of repetitive properties that evidently occur naturally from the interaction of the constituent agents (i.e., the elemental structure) of the system. Some studies have sought to quantify organizational fractality per se (e.g., Dooley & Van de Ven, 1999), but most applications to human organizations persist at the level of qualitative description.

Fractality is especially important in organizational research due to its ability to explain how some of the characteristics of communication exchange in the organization are within the perceptual range of individual respondents. For example, people in an organization may have a better grasp of the general patterns of communication exchange in parts of the organization that are invisible to them than they realize. LMX and TMX simply avoid this question, by refraining from asking questions about the organization at large, as opposed to the unit at hand (Graen & Cashman, 1975; Seers, 1989). FVP instead takes the approach of asking respondents about the organization as a whole (Voss et al., 2014). Indeed, the effort to develop a scale for this purpose revealed that the same outcome is achievable within the context of both LMX and TMX as well (Voss et al., 2014).

Traditional theories of interpersonal communication subdivide the observable process into discrete components. This approach characterized the early studies in communication theory (Phelps, 1942; Pollack, 1953). This model of communication is compatible with that implicit in FVP in the sense that the latter seeks to identify obstructions in the communication flow, which may indeed be observable at the point of encoding, transmitting the information, or decoding. In fact, much of FVP theory focuses on the problem of decoding. Examples of decoding problems that may occur due to fractal obstructions in the information flow include eroded trust conditions in organizations, confusion that occurs due to cultural asymmetries (which imply issues with encoding as well), and perceptions of injustice (Gómez & Rosen, 2001; Voss et al., 2010).

Role theory overlaps with communication theory in this context, providing a model for understanding sources of confusion in people's perceptions of what their organizations expect from them (Kahn, Wolfe, Quinn, Snoek, & Rosenthal, 1964; Roethlisberger & Dickson, 1939). However, while role theory affords a way to understand primarily how problems of transmission may obstruct people's ability to discern accurately and thus respond adequately to expectations, the model is comparatively mechanical (Kahn et al., 1964). Merton (1945, 1957) has explained that people receive their expectations from others in the form of a single psychological gestalt, so conflicts among role-sendings enter the individual's mind as a confused mass of information, rather than a mathematical representation of logical compatibility or conflict. While Kahn et al. (1964) have included the issue of focal persons' personal values and beliefs as a moderator of how they receive their role-sendings, the effect of information obstructions on the emergence of contentions with trust or perceptions of justice have yet to enter role theory per se. In this respect, FVP fills a gap in role theory based on observations taken from complexity theory.

Causes of FVP may include differences in the assumptions driving encoding and decoding in the traditional communication model (Brannen, 2004). Actual obstructions in the communication channels may also be at fault (Daft, Lengel, & Treviño, 1987). Leadership styles may be too directive in nature for the leadership context, such as in the case of a dogmatic leader who tries to manage a team of experienced workers (Muczyk & Reimann, 1987). Effects of FVP may include the aforementioned erosion of the trust condition (Gómez & Rosen, 2001), an undermining of one's sense of procedural justice (Homans, 1961), and the associated confusion that comes from an inability to reconcile one's understanding of one's duty and how one feels about the person who has communicated that expectation (Thibault & Walker, 1975).

Meanwhile, FVP is qualitatively different from LMX, despite the obvious difference in positive versus negative wording (Voss et al., 2014). Specifically, even if one generalizes the LMX construct to enable respondents to reveal insights about the organization as a whole, rather than solely within their immediate units, the statistical relationship between LMX and TMX is no less strong than that between FVP and either of these constructs (Voss et al., 2014). Scoring low on an LMX scale reflects low-quality information exchange along the vertical axis, but it conceals any evidence of actual obstructions. Even though obstructions along vertical communication linkages may indeed be the product of withholding information, at least in part, the distortions in those linkages that develop due to those obstructions change the nature of the relationship qualitatively. Thus, low LMX is capable of correction through training, to enhance the practice of the leader in engaging with subordinates. However, applying the same remedy to FVP might be inconsequential, as the self-reinforcing patterns of information obstruction will constantly confound those efforts. Instead, it is necessary to address FVP in a more fundamental way, including the physical relocation of parties with the noted entrenched patterns of interaction.

METHODOLOGY

Voss et al. (2014) developed a 27-item scale measuring a composite of two forms of FVP (construed as direct and indirect, respectively), along with generalized LMX and generalized TMX, for use in organizational research. The present study uses the same items, rewritten to fit the student experience, while attempting to extend the scales by contriving additional items in each area, resulting in a 40-item survey (i.e., 10 items per construct). The sample included N = 215 midcareer students at two different institutions, including both undergraduate and graduate students and a broad range of age levels (8% were over the age of 40). The two institutions were in the Southeastern and Northwestern United States, respectively, and 35% of the sample reported taking at least half of their courses online, while 34% reported being in traditional classroom environments exclusively. Most students in the sample were within one to two years of their expected graduation, and most students had completed at least an associate's degree. A plurality of the sample was within the range of 21-25 years of age, but 28.5% were over the age of 30. Meanwhile, 14% of the sample hailed from a country other than the United States. The racial composition of the sample was 63.2% European American, 12.7% African American, 7.5% Hispanic, 5.7% Arab, and 5.7% Chinese. Graduate students made up 13.7% of the sample.

Instrument

The scale featured 40 items using a 5-point Likert scale (1 = strongly disagree), of which 10 items represented generalized LMX, 10 represented generalized TMX, and 10 represented each of the two FVP facets revealed in Voss et al. (2014). The instrument also included a scale to measure social-desirability response bias (SDRB), which was an adaption of Crowne and Marlowe (1960), using the 10

strongest items, without alteration. However, this aspect of the study falls outside the intended range of the present factor analysis, in part because the expected interaction between SDRB and FVP was absent in the resulting data and therefore obviated the utility of the SDRB scale. Student respondents took the survey in an online format, using the Qualtrics™ survey platform, in response to a blanket message with the associated link. There was no mechanism for tracking individual responses by student identity, as the intention was to make the survey voluntary and thus bypass any inadvertent effects from pressure to answer in any particular way.

Results

The factor-analytic procedure began with a review of Eigenvalues and the scree plot, using all 40 items in the composite FVP, LMX, and TMX scale. The scree plot indicated six factors (see Figure 1), while the Eigenvalue (Kaiser) criterion indicated the presence of 11 factors. The analytical phase of the study therefore proceeded by running the first analyses with a specification of six factors, using varimax rotation. The criterion by which to remove items from the analysis was to identify any item whose strongest loading on one factor lay within $r < .14$ of the same item's next strongest loading on another factor. This conservative choice of exclusionary principle corresponded to a significance threshold of $\alpha = .05$ for a sample of this size, and the procedure appeared to work smoothly with this feature. (This was the same approach taken in Voss et al., 2014, which worked equally well.)

At the end of this first round, the sixth factor consisted of only two items. One was a TMX item ("we often make suggestions about better study methods to our fellow students"). The other was an FVP item ("some people seem to do everything, while others seem to do nothing"). The lack of obvious theoretical relationship between these items led to the decision to rerun the entire analysis without them, thus specifying five factors in the next run.

In the midst of the process of rerunning the analysis while specifying five factors and having removed the two previously noted items, the Eigenvalue criterion fell short of specifying at least five factors. Consequently, it was reasonable to run the same analysis (i.e., two items short), while specifying four factors instead. The result was a stable 5-factor model, but one LMX item ("I have a lot in common with my professors") loaded on the TMX factor. A review of its compatibility with the other items on that factor suggested removing the item from the list and rerunning the analysis while again specifying four factors.

Figure 1
Scree Plot, Initial 40 Scale Items
(Student-Worded FVP, LMX, and TMX)

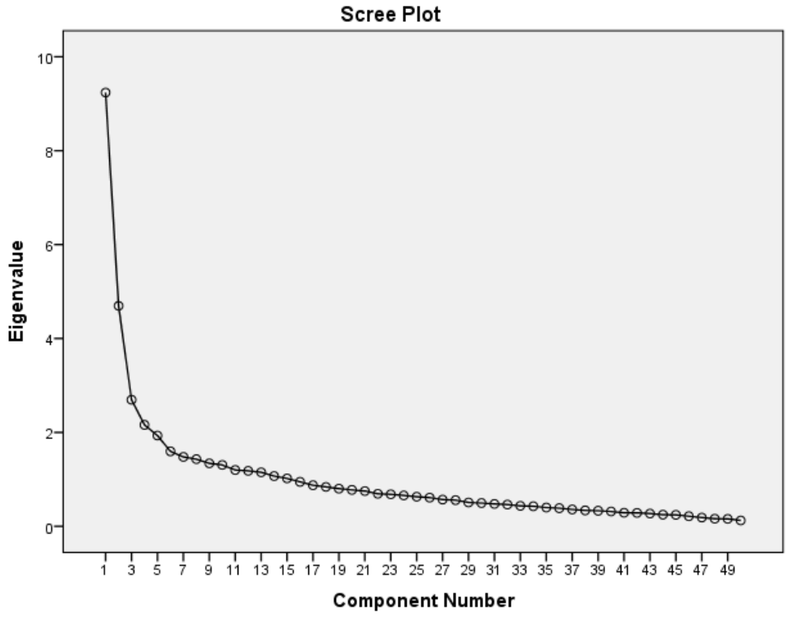

Table 1
Factor-Analytic Results, Student FVP Scale

	F1	F2	F3	Key	Item
1	.674			+	I am too often left in the dark about what my institution is up to.
2	.669			+	To get along, you have to pretend to respect your professors.
3	.638			+	Leaders have little conception of the administrative confusion we face as students.
4	.604			+	The staff too often blame students for failure.
5	.595			+	There is too much secrecy in this institution.
6	.591			+	Around here, obedience is more important than courage.
7	.566			+	The use of threats and penalties is normal here.
8	.558			+	This institution could use more real leadership and less posturing.
9	.554			+	It is best not to stick your neck out around here.
10	.516			+	The administration rejects suggestions for changes.
11	.514			+	Our professors should discuss institutional issues with us more.
12	.496			+	I don't usually expect the staff to carry out the real duties of management.
13	.453			+	It is often easier to solve a problem yourself than it is to ask a staff worker.
14	.431			+	Administrators should come into the trenches more often to see what it's like down here.
15		.721		+	The administration in my institution usually takes responsibility for its own mistakes.
16		.691		+	This institution believes in fairness and justice.
17		.652		+	The staff tries hard to work with the students.
18		.650		+	Administrators actively seek input on ways to make the institution function better.
19		.590		+	The professors treat their students as equals.
20		.581		+	Faculty are very reasonable about how to handle problems when they occur.
21		.556		+	Administrators seek appropriate feedback from students when making big decisions.
22			.734	+	My fellow students would come to the rescue if I had a problem.
23			.624	+	My fellow students and I are open and honest with each other.
24			.592	+	There is good camaraderie among the students.
25			.584	+	I often spend time with my fellow students outside of the classroom as well.
26			.564	+	With difficult tasks, students openly ask one another for help.
27			.445	+	I usually have no problem helping out other students when necessary.

Notes: F1 = student-perceived fractal vertical polarization (FVP); F2 = student-perceived generalized LMX; F3 = student-perceived generalized TMX. Item wording is implicitly positive for LMX and TMX, and negative for FVP, so all keying is positive.

The result was again a stable 4-factor solution, but the content of Factor 4 included three items that seemed to reflect a combination of wording (viz., repetition of the word professors) and possibly irrelevance to the student experience (hence, their content may have confused the respondents, which in turn caused them to load on their own factor). The two similar items were "some professors will take credit for your ideas" and "my professors often make unreasonable requests of me." While both of these items might reflect the experience of a doctoral student, the study only included students working toward their bachelor's or master's degrees, with virtually no presence of graduate assistantships to place students in ethically compromising positions. The third item ("this institution's staff expect students to do their jobs for them") is likely to have loaded onto this factor precisely because it

constitutes another type of experience that is rare in this sample. Thus, the presence of this fourth factor probably reflects a tendency for respondents to answer in a way that reflects confusion over the content of the item, rather than a particular pattern of variance that would render these three items reflective of the same phenomenon. The final step was therefore to remove these items from the list and then rerun the analysis, specifying three factors.

The next run produced a stable 3-factor structure, but one of the TMX items ("we openly discuss issues and problems in the classroom") loaded on the LMX factor. Further reflection suggested that many of the respondents must have understood this item to refer to the formal classroom structure, rather than to fellow students, hence this outcome, but the item-factor loading was modest (r = .389) compared to the remaining items on that factor, possibly indicating some degree of uncertainty over its meaning. Consequently, the decision was to rerun the analysis without that item.

The final run produced a stable 3-factor structure, in which all FVP items loaded on the same factor, all LMX items loaded on the second factor, and all TMX items loaded on the third factor. The student-perceived FVP scale ended up with 14 items in all, while generalized student LMX had seven items, and generalized student TMX had six items.

The final solution produced a surprising finding, given the earlier discovery (Voss et al., 2014) that FVP seemed to have two subsidiary forms. This time, FVP emerged as a unidimensional construct, consistent the original expectations of the theory. This unidimensionality expectation was also consistent with the original scale development effort behind LMX (Graen, Dansereau, Minami, & Cashman, 1973). The generalized-LMX subscale emerged with a degree of strength similar (in terms of number of items and reliability properties) to that previously identified in Voss et al. (2014), but the generalized-TMX scale was considerably stronger in the present case, producing six retained items and showing a reliability close to r = .70. While the latter scale remains weaker than desired and therefore suggests further efforts to build upon it, the result herein seems usable in research already.

Correlation Matrix

Table 2 provides a correlation matrix using the foregoing scale and the demographic items discussed previously. Surprisingly, FVP shows no significant correlations with any of the demographic constructs. Given the nature of the FVP items, many of which include wording that would be hard to express for many people in an open forum, this result suggests that the FVP subscale is quite robust. Between generalized LMX and generalized TMX, however, there is some evidence of correlation with some of the other variables. For example, generalized LMX correlates negatively with the level of one's prior degree. However, this is probably an artifact of the data set, given that the same relationship is unapparent with educational level per se. For its part, generalized TMX correlates negatively with age and positively with educational level. This outcome may be an artifact of the extent to which one experiences team structures in the classroom at the different grade levels. In this sample, older students are more likely to be undergraduate students, given the nontraditional component of the sample. The age effect may be an artifact of the data set, but the relationship between LMX and educational level seems quite meaningful. That is, the graduate students in the sampling frame are largely MBA students in a traditional classroom environment, who are more likely to experience team-based assignments. The presence of team-based assignments therefore appears to enhance reports of generalize team-member exchange. If so, then this observation attests to the general effectiveness of team-based structures educational settings.

Table 2
Correlation Matrix—Demographics and Scale Items

		1	2	3	4	5	6	7	8	9
1	**Online**	—								
2	**Graduating soon**	.01	—							
3	**Degree in hand**	–.14*	.19**	—						
4	**Age**	.41**	.07	.14*	—					
5	**Gender**	.21**	–.22**	–.22**	–.07	—				
6	**Educ. level**	–.24**	.27**	.58**	–.01	–.13	—			
7	**Student FVP**	–.10	.01	.05	–.12	–.08	.02	[.84]		
8	**Student gLMX**	.08	–.03	–.14*	–.02	.06	–.10	–.43**	[.81]	
9	**Student gTMX**	–.27**	.15*	.06	–.16*	–.06	.21**	–.06	.39**	[.68]

*p < .05; **p < .01 (2-tailed tests)

Notes: Bracketed items on the diagonal are reliability coefficients (Cronbach's alpha). Demographic variables: online (frequency); graduating soon (proximity); degree in hand (college level completed); age (categories); gender (1 = male; 2 = female); educational level (1 = undergraduate; 2 = graduate).

Lastly, the correlations among the key scale variables are an important observation. The strongest correlation is the negative one between FVP and generalized LMX. While these constructs are indeed independent, notably after sorting through a factor-analytic process involving a manifestly conservative exclusionary criterion, it remains important to clarify this distinction through further item refinement. The large number of FVP items, for example, is unnecessary, so if the removal of those items from this subscale that load with weaker item-factor correlations may improve the clarity of the distinction between FVP and generalized LMX, it would appear wholly feasible to do so. Meanwhile, a surprising outcome on this measure is the insignificant correlation between FVP and generalized TMX, despite the strong correlation between the latter and generalized LMX. In Voss et al. (2014), generalized LMX and TMX showed a stronger intercorrelation than that between FVP (in the form of either subscale) and either LMX or TMX.

DISCUSSION

The goal of this study was to lay the basis for bringing FVP and associated constructs (viz., generalized LMX and generalized TMX) into the role of evaluating educational institutions on the quality of their communication flow patterns. The premise is that students' experience with their educational institution may help or hinder their classroom performance, for the same reasons for which employees' experience with their organizations on this measure affect their motivation and sense of trust in their leadership. This study accordingly presented the factor-analytic results of a survey of a broad range of mostly midcareer students at two different institutions of higher learning, in two different parts of the country. The results produced three scales of some utility to investigating the effect of institutional factors on student learning, using a theoretical model based in complexity theory.

The next logical step in this study is to undertake refinement of many of the items and replicate the procedure on a new sample. The goal would be to enhance the generalized-TMX scale toward a reliability level similar to what characterizes the FVP and generalized-LMX scales. The FVP scale is also rather lengthy in this study, and there remains the question of whether to retain those items that reference administrators or staff members, as it is difficult to ascertain how the student respondents actually understood these concepts from their unique perspective as students. The question of whether to reduce the FVP scale to a much shorter, unidimensional presentation is also important.

While the scale presented herein would appear to be sufficient for use in actual application to assess the impact of institutional characteristics on student achievement, the objective should nevertheless be to improve its statistical properties, notably on the matter of generalized TMX. After this development, future research should thence pursue answers to the question of what effects institutional communication dynamics may have on student performance. An interesting point of comparison on this topic is the question of what effect school spirit has on student performance, as it is likely that the constructs bear a meaningful relationship. For its part, LMX enhances each employee's tendency to express loyalty to the leader. This loyalty correlates with additional efforts on the part of the affected employees to do well in their roles. If the same is true among students, the combination of FVP, generalized LMX, and generalized TMX may reveal important insights about how to engage students more effectively in the classroom through their relationship with the institution.

The primary limitation in this study is the sample size. While large enough for most purposes at N = 215, the particular shape of the scree plot suggests an uneven distribution of variance. As a result, the factor-analytic process itself becomes harder to manage, as the changing distribution of the rotated model often behaves with some lack of predictability with each subsequent run of the analysis. The common conception about factor analysis is that it is indeed necessary to have a very large sample to ensure a balanced outcome. While there is no consensus over what the ratio should be, it seems reasonable to conclude that the present study would have benefited from a more substantial base.

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