Multilevel Theory and Dynamics
PSYC 798K
Fall 2020
Syllabus

Professor: James A. Grand
Course Time: Tuesday 2:00pm-4:30pm
Location: Online (synchronous Zoom meetings)
Office: 3147A Biology-Psychology
Office Hours: By appointment
Contact: xxxxxxx

Course Description

This Ph.D. level seminar will explore and critically examine principles, methodologies, and analytical approaches for research involving systems and dynamics that span multiple levels of analysis (e.g., time, individual, dyad, team, organization, society). *The primary orientation of this course is theoretical and conceptual*. That is, my main goal is to equip you with foundational knowledge and interpretive skills for helping you think about and capture how human behavior, cognition, and affect changes and unfolds across time, and how those processes emerge and exhibit influence across levels in ways that shape interactions and psychological outcomes. In doing so, we will explore a variety of methodological techniques, analytic approaches, and applications.

Course Structure and What You Can Expect

I consider this a course on "advanced fundamentals." The topics we will cover are "fundamental" in the sense that they are intended to be tools/perspectives that can be generalized to multiple substantive topics. The "advanced" portion of this course lies in the fact that the material we will cover is intended to move beyond cross-sectional and single-level approaches for conducting research and solving problems. Consequently, we will spend relatively little time focusing on specific content areas or domains (e.g., What are mental models?) or summarizing "what we know" about them (e.g., What is the relationship between mental models and performance?"). Instead, our discussions will center on how to conceptualize and operationalize multilevel phenomena relevant to various content areas or domains (e.g., "What are the processes through which mental models form and how can I represent/capture them?") and the implications such information holds for influencing human and system outcomes (e.g., "How can I shape certain processes to influence the development of mental models?"). Again, my hope is that this course introduces you to *new ways and techniques for thinking* that improve your ability to describe, research, and apply concepts of interest to you in your own work.

The course is designed as a seminar; a guided self-learning experience. You will be encouraged to think about and share with the class how the topics we cover could be meaningfully applied to substantive content areas that are of interest to you. Active class participation and preparation is a major component of this course and is expected of everyone. A large component of our class discussion will focus on making sense of the main principles from the readings and collaboratively discussing how these ideas can be applied and/or inform topics relevant to psychology. Your task is to *critically evaluate* the readings and be prepared to *discuss and share your observations* during our meetings. My role will be to facilitate the

learning process: *what YOU get out of the course will ultimately be determined by what YOU put into it*. My hope is that this seminar promotes an open discussion of ideas, thoughts, and exchanges that will benefit all involved as well as stimulate new ideas in our scientific community.

Evaluation

Given the design of the seminar, *active participation* is a key component of the learning experience. Everyone is expected to be prepared to discuss the readings and to present their views. The seminar is also intended to help you develop your critical thinking and reviewing skills. Thus, contributing feedback on your colleagues' presentations and projects will be an important aspect of my evaluations. Finally, you will apply the concepts presented in the course to develop a novel team project. The project will involve you proposing, extending, and describing results from a computational model that elaborates an emergent phenomena unfolding in a multilevel system.

Category	Percentage of Grade
Active participation in discussions & activities	30%
Final presentation for your team project	20%
Final team paper and project materials	50%
Total	**100%**

Readings

The selected readings for this class are diverse and many are complex both conceptually and analytically. I do not expect you to have perfect comprehension of every article we cover in the course; however, I do expect all readings to be completed prior to each class, for you to understand the basic gist of the reading, and to prepare yourself to ask questions and contribute to class discussions on the topic. In preparing for class, you may want to ask yourself some of the following questions:

- Why was this reading assigned?
- In what way does a multilevel perspective change our thinking on the selected topic?
- What is the "proper" level of analysis? At what level do the authors operate?
- Do the levels of theory, measurement, analysis, and conclusion match?
- What did you find interesting about this article?
- In what other areas of OP/OB might we apply the approach, methodology, or conceptualization advanced in this paper?

Team Project

The purpose of this course is to challenge you to explore psychological phenomena in the context of dynamic, multilevel, and social/organizational systems. Multilevel theory (MLT) and the methodological toolkit that has developed around it has become a staple in the industrial-organizational psychology and organizational behavior disciplines. However, and despite its widespread use, MLT has primarily been limited towards developing theory and carrying out empirical research that fits into a relatively narrow window of social/organizational effects. A major goal of this class is to push you into thinking beyond current applications of MLT and thus how we might advance the organizational sciences further. The purpose of the project for this course is to lay the foundations for achieving this goal. As such, our project will (perhaps) be a little different than the types you typically complete for your graduate courses.

In brief, *your task for the project is to develop, code, run, interpret, and write up the results from a computational model that captures an emergent phenomenon unfolding and playing out over time in a multilevel social/organizational system.* I recognize that this may be the first time that many of you have ever had to program a computer simulation—don't worry, I will teach you what you need to know to do this. I also recognize that coming up with an idea for a model, coding it, running simulations, analyzing/interpreting results, and writing up your findings is probably more than you'd be asked to do for a final project in a typical graduate class—don't worry, we will do several things to (hopefully) make this a less stressful experience:

- To lighten the load and spread out the work, the project will be completed in pairs or small groups (max 2-3 people per team).
- Rather than come up with a completely new computational model, your team will be tasked with extending an existing computational model that we will first replicate in class. Although this will somewhat limit the topic scope of the team project, it has the added benefits of (a) giving everyone a "common ground" from which to work, (b) allowing me and your classmates to more easily troubleshoot and problem solve conceptual and/or coding issues, and (c) provide an opportunity for us to explore how different assumptions, choices, and operationalizations—the building blocks of all theories—may (or may not!) lead to different predictions, conclusions, and interpretations. For these purposes, we will use the following as our focal computational model:

  Dionne, S.D., Sayama, H., Hao, C., & Bush, B.J. (2010). The role of leadership in shared mental model convergence and team performance improvement: An agent-based computational model. *The Leadership Quarterly, 21*, 1035-1049.

- To make team assignments and help identify unique topics for each group to work on, you will each contribute several ideas for ways that the focal model could be extended. I will compile those ideas into a list, have you rank order your preferences for each topic, and then make team assignments based on those preferences. In this way, you will have some influence in shaping the team project in a direction that is hopefully aligned with your personal interests.

An overview of the timeline I anticipate for completing the project and associated benchmarks is provided below. There is some flexibility in when and how certain of these tasks can be completed, but sticking to this timeline will help keep your team on track:

- **Week 8:** Read the paper describing the focal computational model (this is provided in the readings for the week of 10/8, but you may want to read it earlier to start thinking about the project sooner!). You will submit your ideas for topics and extensions to the

model by **Monday 10/19**. I will compile the list of topics and then send out for you to review/rank by **Wednesday 10/21**. Assignments to your team and project topic will be made in class on **Thursday 10/22**.

- **Weeks 9-11:** We will work on replicating the focal computational model during our class meetings; however, we will likely not finish all the coding in class. Your goal for these weeks should be to ensure that you/your team has (a) successfully replicated the focal model and (b) identified and begun working on adding the needed revisions/extensions to your model for the team project **by the start of Week 12 (11/16)**.
- **Weeks 12-13:** Finalize the revisions/extensions to the computational model for your team project and begin identifying the simulations you will conduct and data/analyses you will use to examine your model **by the end of Week 12 (11/22)**. If possible, try to complete your simulations **by the start of Week 14 (11/30)**.
- **Weeks 14-15:** Begin conducting your analyses, visualizations, and interpretations of your simulations (Note: this may entail you running additional simulations as needed!). Each team will present their model and discuss/share their simulation results in class on **Thursday 12/10**.
- **Week 16:** Final model and project papers are due by **Friday 12/18**. The final materials you turn in for the project and paper should include everything described in the sections below.

Paper & Project Requirements

You will submit two items for your final project—a paper and your final model/simulation code.

Paper requirements

There are no strict page length requirements for the paper, though I anticipate that it will take around 15-20 pages to adequately summarize your model and results. The structure for the paper can vary, but it should contain the following "core" elements:

1. A *conceptual* description of the extensions/revisions you made to the original model, the supporting logic/rationale for these extensions, and the research questions you want to explore in the model (i.e., why did you make these extensions, what unique insights or questions do you want to examine, how are these relevant/valuable to the literature, etc.)
2. A descriptive summary of your model's "pseudocode" (i.e., summary of how the model "works" that is sufficient for a reader to grasp what is occurring as the model plays out)
3. A summary of the simulation(s) you conducted that describes and justifies (a) the parameters manipulated and (b) the data recorded/examined for analysis
4. A summary of your simulation findings and analyses that provides insights into your research questions of interest
5. A (brief) summary of the predictions generated by your model, future directions for empirical research based on your simulations, and potential extensions/refinements to improve and/or advance your computational theory/model

Project code requirements

You will submit the final R files containing the model code and simulation scripts used to generate the data reported in your final paper. Ideally, these script files will be clearly commented so that another person could look at your code and easily understand what is happening. You are NOT required to submit any of the data produced by your simulation(s) or any additional files/scripts used to clean and analyze your data, though you may if you want.

Overview of Topics (Subject to change)

Week	Date	Topic	Unit
1.	9/3	Introduction & course overview	
2.	9/10	Organizations as systems	**"Classic" & Contemporary Principles of MLT**
3.	9/17	Principles of MLT (Part I)	
4.	9/24	Principles of MLT (Part II)	
5.	10/1	Aggregation, analysis, & validation in MLT	
6.	10/8	Dynamics and emergence in ML systems ***Guest speaker**: Goran Kuljanin (DePaul University)*	**Key Concepts for Advancing ML Thinking**
7.	10/15	Network science and MLT ***Guest speaker**: Michael Braun (DePaul University)*	
8.	10/22	Computational theory ***DUE 10/19: FINAL PROJECT IDEAS*** ***DUE 10/21: TOPIC/PROJECT RANKINGS***	
9.	10/29	Model building fundamentals in R	**Building & Evaluating Theories Involving Dynamic ML Systems**
10.	11/5	Agent-based model building in R	
11.	11/12	Agent-based model building in R	
12.	11/19	Simulating agent-based models in R Analyzing, interpreting, and visualizing models	
13.	11/26	NO CLASS – Have a Happy Thanksgiving!	
14.	12/3	Simulating agent-based models in R Analyzing, interpreting, and visualizing models	
15.	12/10	***Project presentations***	
16.	Finals Week	***Wrap-up & reflection*** ***DUE 12/18: FINAL PAPER & PROJECT MATERIALS***	

Reading List & Course Schedule (Subject to change)

1. **Introduction & course overview**

No readings

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2. **Organizations as systems**

von Bertalanffy, L. (1950). The theory of open systems in physics and biology. *Science, 111*, 23-29.

von Bertalanffy, L. (1972). The history and status of general systems theory. *Academy of Management Journal, 15*, 407-426.

Katz, D., & Kahn, R.L. (1978). *The social psychology of organizations*. New York, NY: Wiley (Chapters 1-2, pp. 1-34).

Roberts, K.H., Hulin, C.L., & Rousseau, D.M. (1978). *Developing an interdisciplinary science of organizations*. San Francisco: Jossey-Bass (Chapters 1-2, pp. 1-47).

Weick, K.E. (1976). Educational organizations as loosely coupled systems. *Administrative Science Quarterly, 21*, 1-19.

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3. **Principles of MLT (Part I)**

Rousseau, D.M. (1985). Issues of level in organizational research: Multilevel and cross-level perspectives. In L.L. Cummings & B. Staw (Eds.), *Research in organizational behavior* (Vol. 7, pp. 1-37). Greenwich, CT: JAI Press.

Klein, K.J., Dansereau, F., & Hall, R.J. (1994). Levels issues in theory development, data collection, and analysis. *Academy of Management Review, 19*, 195-229.

House, R., Rousseau, D.M., & Thomas-Hunt, M. (1995). The meso paradigm: A framework for integration of micro and macro organizational behavior. In L.L. Cummings & B. Staw (Eds.), *Research in organizational behavior* (Vol. 17, pp. 71-114). Greenwich, CT: JAI Press.

Kozlowski, S.W.J., & Klein, K.J. (2000). A multilevel approach to theory and research in organizations: Contextual, temporal, and emergent processes. In K.J. Klein & S.W.J. Kozlowski (Eds.), *Multilevel theory, research, and methods in organizations: Foundations, extensions, and new directions* (pp. 3-90). San Francisco, CA: Jossey-Bass.

Gully, S.M., & Phillips, J.M. (2019). On finding your level. In S.E. Humphrey & J.M. LeBreton (Eds.), *The handbook of multilevel theory, measurement, and analysis* (pp. 11-38). Washington, DC: American Psychological Association.

[optional: The following two commentaries provide a brief and interesting back and forth on several of the points raised by Klein et al. (1994) – worth a quick read]

George, J.M., & James, L.R. (1994). Levels issues in theory development. *Academy of Management Review, 19*, 636-640.

Klein, K.J., Dansereau, F., & Hall, R.J. (1995). On the level: Homogeneity, independence, heterogeneity, and interactions in organizational theory. *Academy of Management Review, 20*, 7-9.

4. **Principles of MLT (Part II)**

Campbell, D. T. (1958). Common fate, similarity, and other indices of the status of aggregates of persons as social entities. *Behavioral Science, 3*, 14-25.

Freeman, J. (1980). The unit problem in organizational research. In W.M. Evan (Ed.), *Frontiers in organization and management* (pp. 59-68). New York, NY: Praeger.

Chan, D. (1998). Functional relations among constructs in the same content domain at different levels of analysis: A typology of composition models. *Journal of Applied Psychology, 83*, 234-246.

Morgeson, F.P., & Hofmann, D.A. (1999). The structure and function of collective constructs: Implications for multilevel research and theory development. *Academy of Management Review, 24*, 249-265.

Mathieu, J.E., & Luciano, M.M. (2019). Multilevel emergence in work collectives. In S.E. Humphrey & J.M. LeBreton (Eds.), *The handbook of multilevel theory, measurement, and analysis* (pp. 163-186). Washington, DC: American Psychological Association.

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5. **MLT methods: Aggregation, analysis, & validation**

Before class, install the base R program for your OS (http://cran.us.r-project.org) and install the `multilevel`, `nlme`, *and* `lme4` *packages. I also recommend downloading and using RStudio (http://www.rstudio.com/products/rstudio/download) when using R, but it is not required.*

Jebb, A.T., Tay, L., Ng, V., & Woo, S. (2019). Construct validation in multilevel studies. In S.E. Humphrey & J.M. LeBreton (Eds.), *The handbook of multilevel theory, measurement, and analysis* (pp. 253-278). Washington, DC: American Psychological Association.

Krasikova, D.V., & LeBreton, J.M. (2019). Multilevel measurement: Agreement, reliability, and nonindependence. In S.E. Humphrey & J.M. LeBreton (Eds.), *The handbook of multilevel theory, measurement, and analysis* (pp. 279-304). Washington, DC: American Psychological Association.

Gonzalez-Roma, V., & Hernandez, A. (2017). Multilevel modeling: Research-based lessons for substantive researchers. *Annual Review of Organizational Psychology and Organizational Behavior, 4*, 183-210.

Enders, C.K., & Tofighi, D. (2007). Centering predictors in cross-sectional multilevel models: A new look at an old issue. *Psychological Methods, 12*, 121-138

Scherbaum, C.A., & Pesner, E. (2019). Power analysis for multilevel research. In S.E. Humphrey & J.M. LeBreton (Eds.), *The handbook of multilevel theory, measurement, and analysis* (pp. 329-352). Washington, DC: American Psychological Association.

[optional] Preacher, K.J., Zyphur, M.J., & Zhang, Z. (2010). A general multilevel SEM framework for assessing multilevel mediation. *Psychological Methods, 15*, 209-233.

[skim as needed] Bliese, P. (2016). Multilevel modeling in R: A brief introduction to R, the multilevel package and the nlme package

6. **Dynamics and emergence in ML systems**

* FOCAL COMPUTATIONAL MODEL FOR TEAM PROJECT *

Dionne, S.D., Sayama, H., Hao, C., & Bush, B.J. (2010). The role of leadership in shared mental model convergence and team performance improvement: An agent-based computational model. *The Leadership Quarterly, 21*, 1035-1049.

Goldstein, J. (1999). Emergence as a construct: History and issues. *Emergence, 1*, 49-72.

Corning, P.A. (2002). The re-emergence of "emergence": A venerable concept in search of a theory. *Complexity, 7*, 18-30.

Aiken, J.R., Hanges, P.J., & Chen, T. (2019). The means are the ends: Complexity science in organizational research. In S.E. Humphrey & J.M. LeBreton (Eds.), *The handbook of multilevel theory, measurement, and analysis* (pp. 115-140). Washington, DC: American Psychological Association.

Kozlowski, S.W.J., Chao, G.T., Grand, J.A., Braun, M.T., & Kuljanin, G. (2013). Advancing multilevel research design: Capturing the dynamics of emergence. *Organizational Research Methods, 16*, 581-615.

Gorman, J.C., Dunbar, T.A., Grimm, D., & Gipson, C.L. (2017). Understanding and modeling teams as dynamical systems. *Frontiers in Psychology, 8*, 1053.

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7. **Network science and MLT**

Brass, D.J., & Borgatti, S.P. (2019). Multilevel thoughts on social networks. In S.E. Humphrey & J.M. LeBreton (Eds.), *The handbook of multilevel theory, measurement, and analysis* (pp. 187-200). Washington, DC: American Psychological Association.

Paruchuri, S., Goossen, M.C., & Phelps, C. (2019). Conceptual foundations of multilevel social networks. In S.E. Humphrey & J.M. LeBreton (Eds.), *The handbook of multilevel theory, measurement, and analysis* (pp. 201-221). Washington, DC: American Psychological Association.

Kalish, Y. (2013). Harnessing the power of social network analysis to explain organizational phenomena. In J.M. Cortina & R.S. Landis (Eds.), *Modern Research Methods for the Study of Behavior in Organizations* (pp. 99-135). New York, NY: Routledge.

Contractor, N.S., Wasserman, S., & Faust, K. (2006). Testing multitheoretical, multilevel hypotheses about organizational networks: An analytic framework and empirical example. *Academy of Management Review, 31*, 681-703.

Carter, D.R., DeChurch, L.A., Braun, M.T., & Contractor, N.S. (2015). Social network approaches to leadership: An integrative conceptual review. *Journal of Applied Psychology, 100*, 3, 597-622.

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8. **Computational theory**

Macy, M.W., & Willer, R. (2002). From factors to actors: Computational sociology and agent-based modeling. *Annual Review of Sociology, 28*, 143-166.

Davis, J.P., Eisenhardt, K.M., & Bingham, C.B. (2007). Developing theory through simulation methods. *Academy of Management Review, 32*, 480-499.

Harrison, J.R., Lin, Z., Carroll, G.R., & Carley, K.M. (2007). Simulation modeling in organizational and management research. *Academy of Management Review, 32*, 1229-1245.

Epstein, J. M. (1999). Agent-based computational models and generative social science. *Complexity, 4*, 41-60.

Smith, E.R., & Conrey, F.R. (2007). Agent-based modeling: A new approach for theory building in social psychology. *Personality and social psychology review, 11*, 87-104.

[optional] Macal, C.M., & North, M.J. (2010). Tutorial on agent-based modeling and simulation. *Journal of Simulation, 4*, 151-162.

9-14. **Example computational modeling papers**

The readings below are intended to offer a few examples of published computational modeling papers that explore dynamic, emergent, and multilevel phenomena in the social and organizational sciences. Except for the Dionne et al. (2010) paper, these are optional readings that will not be a direct focus of discussion in class. However, I STRONGLY recommend that you read (or do a deep skim) of at least a few of these to get a sense for how to write a paper that presents a computational model.

Coen, C.A. (2006). Seeking the comparative advantage: The dynamics of individual cooperation in single vs. multiple-team environments. *Organizational Behavior and Human Decision Processes, 100*, 145-159.

Dionne, S.D., Sayama, H., Hao, C., & Bush, B.J. (2010). The role of leadership in shared mental model convergence and team performance improvement: An agent-based computational model. *The Leadership Quarterly, 21*, 1035-1049.

Grand, J.A., Braun, M.T., Kuljanin, G., Kozlowski, S.W.J., & Chao, G.T. (2016). The dynamics of team cognition: A process-oriented theory of knowledge emergence in teams [Monograph]. *Journal of Applied Psychology, 101*, 1353-1385.

March, J.G. (1991). Exploration and exploitation in organizational learning. *Organization Science, 2*, 71-87.

Nowak, A., Gelfand, M.J., Borkowski, W., Cohen, D., & Hernandez, I. (2016). The evolutionary basis of honor cultures. *Psychological Science, 27*, 12-24.

Samuelson, H.L., Levine, B.R., Barth, S.E., Wessel, J.L., & Grand, J.A. (2019). Exploring women's leadership labyrinth: Effects of hiring and developmental opportunities on gender stratification. *Leadership Quarterly, 30*, 101314.

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15. **Class presentations**

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16. **Final project and papers due**