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# Multilevel and Mixed Methods Approaches in Modelling and Evaluation

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- multilevel theory and research in organizations: foundations and opportunities in management
- designing, conducting and evaluating multilevel studies
- elements of methods for multilevel empirical studies
- mixed methods:
  - what classifies as mix methods designs
  - dimensions
  - mixed-methods multilevel evaluation

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# Multilevel theory and research in organizations: foundations and opportunities in management

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## ORGANIZATIONS AS MULTILEVEL SYSTEMS

- organizations ARE multilevel systems
- this assumption is reflected in the very earliest examples of organizational theory, e.g., the Hawthorne studies, the theory of groups formation of Homan, the social organization theory of Katz and Kahn, the field theory of Lewin, the organizational effectiveness theory of Likert ...
- contemporary theories of organizational behaviour are also found on this axiom, e.g. organizational learning theory with contributions from many authors

→ !! unfortunately, while the relevance of organizational systems theory is well recognized, its influence in organizational science is just metaphorical !!

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## A SLICED APPROACH TO THE ORGANIZATION

the "system" is sliced into levels


- each level becomes the feud of diferent disciplines, theories and methodological approaches
- !! the real organization may be an integrated system, but organization science is not !!

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## A NEW PARADIGM IN ORGANIZATIONAL SCIENCE

- we need to move to an integrated conceptual and methodological paradigm for organizational sciences
- such paradigm must be able to bridge the micro-macro gap in theory and research
- we need a multilevel paradigm in organizational science

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## THE NEED FOR MULTILEVEL RESEARCH

- 1. to bridge the micro-macro gap
- 2. to bridge the rearch-practice gap
- 3. to foster the integration of theories from different disciplines and facilitate theoretical development, improving knowledge of organizational and business phenomena
- 4. to avoid the problems and fallacies of the wrong level, including wrong model specification

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## 1. BRIDGING THE MICRO-MACRO GAP

- the development of management research is characterized by growing diversity and specialization
- several areas emerged and consolidated, both in teaching and research
- macro areas, e.g., strategic management and organization theory, mainly focus on research questions and analysis at the organizational level
- micro areas, e.g., organizational psychology and organizational behavior, mainly focus on research questions and analysis at the individual and group level within the organization
- this separation is also reflected in the creation of specific divisions within management associations, separate and independent sessions within conferences and specialized journals

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## 1. BRIDGING THE MICRO-MACRO GAP

- benefits in specialization include allowing the deepening of specific subjects
- less positive aspects include growing separation and fragmentation reflected in the development of a micro-macro gap
- multilevel research can help to bridge this gap by integrating disciplines and levels of analysis
- multilevel research emphasizes the joint analysis of variables located at different levels, examining relationships between them, e.g., studying variables at the micro (individual or group) level and variables at the macro (organization) level, and then integrate these levels bridging the micro-macro gap
- multilevel research can also integrate other levels, e.g., examining the importance of determinants of firm performance, including firm, corporate, industry, cluster/strategic group and location effects; levels below the organizational level may also be integrated (e.g., individuals, work group ..)

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## 2. BRIDGING THE SCIENCE-PRACTICE GAP

- the so-called science-practice, research-practice or academic rigor-practical relevance gap, WHY?
- specialization and fragmentation in research may lead to independent and very specific studies that do not reflect real-world business problems
- many times, very specific academic studies are far from real-world issues and solutions ... or the way the research questions and the studies' outcomes are formulated are ...
- specialization and fragmentation into diverse disciplines and research areas leads to oversimplification of the organizational practice becoming of little interest for companies and managers
- real-world example: the organization culture or a performance management system, both variables at the organizational level, may affect the motivation and satisfaction of employees, which in turn may also influence both firm and individual performance

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## 2. BRIDGING THE SCIENCE-PRACTICE GAP

- in business practice (e.g., decision making by managers), elements at different levels are usually involved
  - levels: a human resources management system at the organizational level, characteristics of managers and employees and their behaviors, and interactions between managers and employees, at the individual and/or group levels
- the problems that managers must solve involve actions and variables at different levels and from several disciplines within management.
- the joint analysis of several levels through multilevel studies can close this science-practice gap, bringing science closer to the real-world business practice and promoting relevant, responsible research

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## 3. INTEGRATION OF THEORIES AND THEORETICAL DEVELOPMENT

- multilevel research can promote the improvement of theoretical development by facilitating the understanding of business phenomena with antecedents and/or consequences in different contexts and at different levels
- it opens the possibility for theoretical development and the improvement of knowledge of business phenomena, contributing to the advance of management research and practice
- case 1: analyses of the impact that variables located at two or more levels have on a dependent variable located at one of these levels - direct effects
- case 2: analyses of a cross-level interaction, on how the relationship between two variables at the same level is moderated by a variable at a different level

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### 3. INTEGRATION OF THEORIES AND THEORETICAL DEVELOPMENT

key takeaway

- multilevel research is key in initiatives where micro areas try to integrate macro issues and macro areas aim to integrate micro issues
- multilevel research is relevant in multidisciplinary studies that integrate theories, variables, relationships and processes from different micro and macro areas at different levels of analysis

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### 4. THE PROBLEMS AND FALLACIES OF THE WRONG LEVEL

- most data in social science research come from phenomena where subjects are part of nested hierarchies
  - employees nested in work groups or departments, which are grouped into firms nested in industries that are part of ecosystems
- there were two ways to study this kind of nested data, before the use of multilevel research: aggregation and disaggregation

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## 4. THE PROBLEMS AND FALLACIES OF THE WRONG LEVEL

- aggregation and disaggregation may lead to errors, when conclusions are drawn at the wrong level!!
  - when inferences and interpretations are made about relationships between variables at a certain level, but the analysis has been carried out at a different level
  - when an effect, variable or relationship are attributed to a level of analysis when they really refer to a different level

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## 4. THE PROBLEMS AND FALLACIES OF THE WRONG LEVEL

### aggregation

- consists of collecting data at a lower level and combining the values of those variables to the higher level

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## 4. THE PROBLEMS AND FALLACIES OF THE WRONG LEVEL

- aggregation case.1; having data from several employees working in different companies and all the variables of interest in a model are at the organizational level
  - the average for each company is calculated from their employees
  - the analysis is then carried out at that organizational level
  - if the interest is in the relationships between variables at this organizational level, because this is the theoretical level of hypotheses, then there is no problem

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## 4. THE PROBLEMS AND FALLACIES OF THE WRONG LEVEL

- aggregation case.2: having data from several employees working in different companies and the theoretical level of interest is also the individual level (employees)
  - the average for each company is calculated from their employees
  - the analysis is carried out at the organizational level
  - interpreting the results of the organizational relationships and generalizing them at the level of employees would be a mistake – ecological fallacy
  - results that refer to the companies cannot by applied to individuals

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## 4. THE PROBLEMS AND FALLACIES OF THE WRONG LEVEL

ecological fallacy

- aggregation case.2: what is wrong?
  - having eliminated the variance within companies, the relationships may be strong at the organizational level, but the reality may be very different at the individual level
  - there are both a statistical problem and a conceptual/theoretical problem
  - statistical problem: the data from employees were combined to form a smaller number of company values, losing much information and power in the statistical analyses
  - conceptual problem: results that are valid at the company level are interpreted as if they were also valid at the individual level

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## 4. THE PROBLEMS AND FALLACIES OF THE WRONG LEVEL

disaggregation

- consists of disaggregating data from higher-level units into data on a larger number of lower-level units

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## 4. THE PROBLEMS AND FALLACIES OF THE WRONG LEVEL

- disaggregation case.1; the values of the variables at the company level are assigned to their corresponding employees, which would also have individual values for other variables
  - the analysis is carried out at the individual level: what is wrong?
  - statistical problem: lack of independence, as employees of two different companies are independent, but two employees working in the same company are not independent, as they receive common influences and that reflects on their observations
  - conceptual problem: no interpretation or inferences can be made at the company level based on the analysis developed at the individual level

atomistic fallacy

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## 4. THE PROBLEMS AND FALLACIES OF THE WRONG LEVEL

key takeaway

- aggregation and disaggregation lead to irrelevant conclusions regarding a certain level when using data collected and analyzed at a different level
- multilevel research helps with dealing with this problem that arises from ignoring the nested and hierarchical structure of data
- this methodological approach solves the dilemma between aggregation and disaggregation, working with several levels simultaneously

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## BASICS IN MULTILEVEL RESEARCH

- 1. foundational studies on multilevel research in maangement
- 2. principles of multilevel research

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## 1. FOUNDATIONAL STUDIES ON MULTILEVEL RESEARCH

- main principles, methodological foundations and techniques were developed in other fields, e.g., psychology, education
- in management, authors from micro areas, such as organizational behavior and organizational psychology were the source of the pioneering works (conceptual, theoretical, methodological and empirical) on multilevel research

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## 1. FOUNDATIONAL STUDIES ON MULTILEVEL RESEARCH

- Rousseau (1985) introduced key aspects of multilevel research in the field of management in general, and in organizational behavior in particular
- Klein and Kozlowski(2000) edited *Multilevel theory, research and methods in organizations*, a book that contributed to the progress and consolidation of multilevel research in management, clarifying and establishing the main foundations of multilevel theory and research methods
- Yammarino and Dansereau edited a book series (*Research in multi-level issues*) with several volumes, between 2002 and 2009
- several journals have published special issues on multilevel research and the micro-macro divide, e.g., the Academy of Management Review, the Journal of Management, the Academy of Management Journal, Organizational Research Methods
- methodological works and literature reviews have examined empirical studies published in these areas

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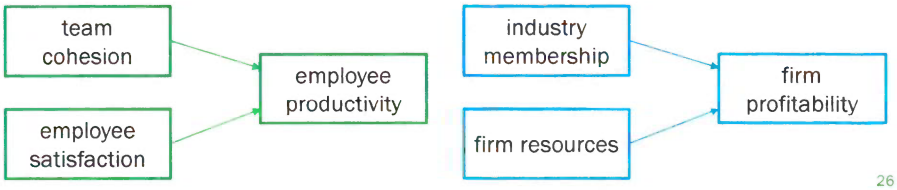
## 2. PRINCIPLES OF MULTILEVEL RESEARCH

nested and hierarchical structure, main models and relationships

- key insights of multilevel research
  - the existence of a hierarchical system of several levels, where some entities reside in nested structures
  - the fact that variables at each level may influence variables at other levels

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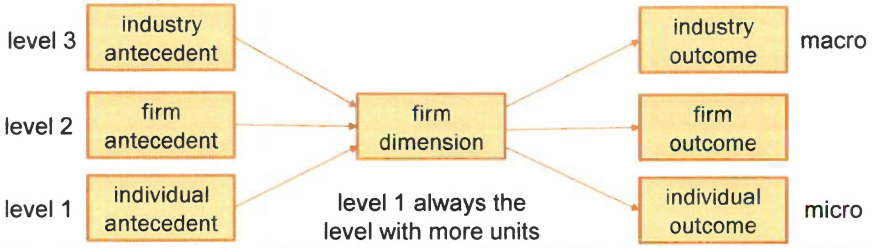
## 2. PRINCIPLES OF MULTILEVEL RESEARCH

### nested and hierarchical structure, main models and relationships

- key insights of multilevel research
  - influences may be reciprocal between the levels
  - a phenomenon at any level may have antecedents and consequences at other levels

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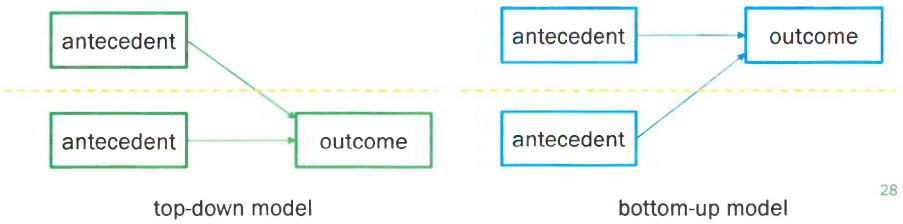
## 2. PRINCIPLES OF MULTILEVEL RESEARCH

### nested and hierarchical structure, main models and relationships

- key insights of multilevel research
  - most studies examine two levels
  - there are two main types of direct relationships and models

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## 2. PRINCIPLES OF MULTILEVEL RESEARCH

### nested and hierarchical structure, main models and relationships

- example of top-down model from human resources
  - explanatory variable at the individual level: motivation (L1)
  - explanatory variable at the organizational level: organizational practice (L2)
  - dependent variable: individual performance of each employee (L1)
  - traditional multilevel analysis techniques, such as hierarchical linear models (HLM), were developed for these top-down models

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## 2. PRINCIPLES OF MULTILEVEL RESEARCH

### nested and hierarchical structure, main models and relationships

- example of bottom-up model from human resources
  - explanatory variable at the individual level: motivation (L1)
  - explanatory variable at the organizational level: organizational practice (L2)
  - dependent variable: firm profitability (L2)

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## 2. PRINCIPLES OF MULTILEVEL RESEARCH

nested and hierarchical structure, main models and relationships

- in previous examples, there is a pure and strict hierarchical relationship, as each unit of the micro level is nested in one, and only one, unit of the macro level
  - employees are nested in firms
  - employees are nested in firms that are nested in industries

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## 2. PRINCIPLES OF MULTILEVEL RESEARCH

nested and hierarchical structure, main models and relationships

- an extension is multilevel cross-classification
  - several macro levels are used, and the units of the micro level are nested simultaneously in these macro levels, but no pure and strict hierarchy between the macro levels exists
  - example with firms (micro level), strategic groups (macro level) and regions (macro level)
  - a region can have firms from different strategic groups, and firms from the same strategic group can be in different regions

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## 2. PRINCIPLES OF MULTILEVEL RESEARCH

nested and hierarchical structure, main models and relationships

- another extension is multiple membership
  - example: multilevel study with multiple membership and cross-classification
  - role of two types of employees at the micro level, designers and managers, on the development of different games, the macro level
  - each of the designers and managers work on the development of more than one game, being members of multiple groups

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## 2. PRINCIPLES OF MULTILEVEL RESEARCH

nested and hierarchical structure, main models and relationships

- another extension is the analyzes of longitudinal data
  - longitudinal data can be seen as multilevel data, with repeated measures corresponding to the lower level (data on firm productivity for several years) and firms being the higher level
  - in a study with repeated measures and firms, repeated measures are nested in the firms, and are correlated within each firm

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## 2. PRINCIPLES OF MULTILEVEL RESEARCH

### assuming the existence of dependency

- as a consequence of nested structures, multilevel research must deal with the lack of independence
  - example
    - when students are grouped within the same classroom, they share the same context variables of the classroom (e.g., teachers)
    - students in the same group interact and this may lead to similarities in terms of performance

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## 2. PRINCIPLES OF MULTILEVEL RESEARCH

### assuming the existence of dependency

- the assumption of independence of observations of the classical linear model is not fulfilled
- there are important statistical implications
  - the application of traditional regression analysis with nested data increases the probability of type I error - greater probability of rejecting the null hypothesis when it is true
  - this is because the existence of dependence will lead to obtaining a p value lower than the correct one, indicating greater statistical significance
- with nested data, it is not appropriate to use traditional regression analysis

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## 2. PRINCIPLES OF MULTILEVEL RESEARCH

### levels of theory, measurement, data source and analysis

- level of theory: entity or focal unit on which it is intended to generalize; it is the level at which a particular construct of effect is predicted to exist
- level of measurement: entity relative to which a construct is applied (e.g., firm - firm competitive strategy)
- level of data source: level the entity providing the data belongs (e.g., managers reporting on firms' competitive strategy)
- level of analysis: unit to which data are assigned for hypothesis testing and statistical analysis

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## 2. PRINCIPLES OF MULTILEVEL RESEARCH

### levels of theory, measurement, data source and analysis

- the focal unit determines a specific level (e.g., industry, organization, group, individuals) but in multilevel research different levels are considered
- researchers must clearly determine these levels to be able to properly study theoretical relationships between them
- a specific theory may include constructs residing at different levels -> researchers must be careful when determining the level of each construct

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## 2. PRINCIPLES OF MULTILEVEL RESEARCH

### levels of theory, measurement, data source and analysis

- it is important to align the levels of theory and measurement with the level of analysis
- levels misalignment may lead to problems related to fallacies of the wrong level
- still, the level of measurement may differ from the level of analysis when a proper process of aggregation is implemented
- however, aggregation must be justified, both theoretically (are there processes that relate the two levels described in the literature?) and statistically (examining the level of agreement in individual assessments)

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## 2. PRINCIPLES OF MULTILEVEL RESEARCH

### the case for the application of multilevel research

- the existence of nested structures and dependences
- the availability of sufficient data at the levels analyzed
- still, a statistical justification is required to conduct a multilevel analysis: contextual variables at the macro level should exert an influence on the micro-level variables
  - several indices may be used in the statistical justification, e.g., the intraclass correlation coefficient 1, or ICC(1), which determines which part of the variance of the dependent variable at the lower level is due to the higher-level variability
  - a high intergroup variability would justify the search for higher-level predictors

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## 2. PRINCIPLES OF MULTILEVEL RESEARCH

### a multilevel theory may not need a multilevel design

- the upper echelons theory incorporates features on individuals (mainly CEO), groups (top management team) and organization
- still, if a study focus on the organizational level, with only a CEO and a top management team, a multilevel design is not required

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## THEORETICAL, METHODOLOGICAL AND ANALYTICAL ASPECTS

### theories and models in multilevel research

- the first and fundamental step in multilevel research is the definition of theoretical and conceptual elements
  - to provide the theoretical arguments that serve to specify the model of the study
  - to justify the relationships between variables and the processes and mechanisms that connect the variables at different levels
  - to establish the constructs and their definition, and justify their levels
  - several theories that examine relationships at different levels may be integrated
  - theories that link constructs at different levels may be used

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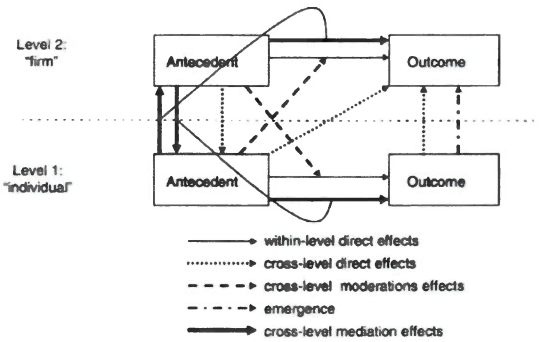
## THEORETICAL, METHODOLOGICAL AND ANALYTICAL ASPECTS

### theories and models in multilevel research

- the first and fundamental step in multilevel research is the definition of theoretical and conceptual elements

→models may incorporate within-level direct effects and cross-level direct effects

→other effects can be included, e.g., cross-level mediation effects, cross-level moderation effects and aggregation/emergence processes

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## THEORETICAL, METHODOLOGICAL AND ANALYTICAL ASPECTS

### sampling and data collection in multilevel research

- in multilevel research, sampling is carried out in stages
- it must consider the levels that are defined
  - in a study with two levels, organization and individual, there must be enough organizations (first stage of sampling) and enough individuals in each organization (second stage) to reach suitable statistical power
- a 30/30 (organizations/individuals per organizations) rule of thumb is usually indicated as the minimum to reach enough power for cross-level direct effects and cross-level interactions

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## THEORETICAL, METHODOLOGICAL AND ANALYTICAL ASPECTS

### sampling and data collection in multilevel research

- in practice, studies consider fewer units in the lower level, assuming that it is more important to have a large number of elements in the higher level than in the lower level
- depending on the multilevel analysis techniques and the multilevel effects defined in the model (interactions, direct effects, . . .), specific requirements of sample sizes may apply

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## THEORETICAL, METHODOLOGICAL AND ANALYTICAL ASPECTS

### sampling and data collection in multilevel research

- multilevel research may use primary data sources or secondary data
- researchers must determine the appropriate informants for specific constructs to avoid social desirability bias
  - in a study about leadership in teams, leaders/managers/supervisors in these teams may provide biased information about their own leadership style
  - beside deciding for managers and/or employees it may be necessary to determine specific hierarchical levels, jobs, specific workers in specific teams ..

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## THEORETICAL, METHODOLOGICAL AND ANALYTICAL ASPECTS

### aggregation and collective constructs

- for bottom-up relationships, influences between variables at different levels are different from aggregation or emergence of collective constructs
- aggregation refers to the emergence of a variable at a higher level, resulting from the aggregation of characteristics or perceptions of some units at a lower level (e.g., organizational culture)
- aggregation must be justified from the theoretical and the statistical point of view
- understanding the nature of higher-level constructs and the processes involved in their emergence is crucial, theoretically

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## THEORETICAL, METHODOLOGICAL AND ANALYTICAL ASPECTS

### aggregation and collective constructs

- two basic aggregation or emergence principles: composition and compilation
- in the composition process, each unit at the lower level contributes equally to the index that represents the variable at the higher level
  - descriptive statistics (such as the sum of individual scores or mean) adequately represent the processes in which the lower-level data are associated with a higher-level collective construct
- in the compilation process, the higher-level phenomenon is a complex combination of the contributions of the lower-level units, and descriptive statistics cannot be applied

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## THEORETICAL, METHODOLOGICAL AND ANALYTICAL ASPECTS

### aggregation and collective constructs

- collective constructs are characteristics or properties of some group at some higher level that includes units at a lower level
- three main types of collective constructs: global, shared and configural constructs
- global constructs are descriptive characteristics of the group (e.g., the size of a firm considering the number of employee)
  - objective attribute that do not depend on individual perceptions or behavior; there is no aggregation involved
  - does not cross levels, and only operate at the group level
  - It may influence the characteristics of members in the group

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## THEORETICAL, METHODOLOGICAL AND ANALYTICAL ASPECTS

### aggregation and collective constructs

- shared and configural constructs cross levels
- shared constructs may only exist and have validity when members of the specific group share similar perceptions
  - homogeneity is considered in the sense that all individuals are equally important
  - shared constructs are linked to composition processes of emergence

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## THEORETICAL, METHODOLOGICAL AND ANALYTICAL ASPECTS

### aggregation and collective constructs

- shared and configural constructs cross levels
- in configural constructs, individual actions, characteristics or perceptions combine in some complex and non-linear way
  - there is no homogeneity, as some individuals may contribute more than others
  - configural constructs are associated with compilation processes

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## THEORETICAL, METHODOLOGICAL AND ANALYTICAL ASPECTS

### aggregation and collective constructs

- validity and reliability are important aspects of collective constructs
- the wording of survey items used to measure group-level constructs (collective constructs) through individual-level data must also be carefully considered

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## THEORETICAL, METHODOLOGICAL AND ANALYTICAL ASPECTS

### analysis in multilevel research

- multilevel analysis, using multilevel statistical techniques, is a very important part of multilevel research
- great advances have been made in multilevel statistical analysis
  - on statistical justification of aggregation of lower-level variables, allowing the creation of higher level, collective variables
  - on multilevel statistical techniques to analyze relationships between variables at different levels, including cross-level direct effects, cross-level moderation effects and cross-level mediation effects

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## THEORETICAL, METHODOLOGICAL AND ANALYTICAL ASPECTS

### analysis in multilevel research

- on statistical justification of aggregation ...
  - statistical aggregation may be supported using several indices and statistical coefficients
  - two main types of indices: indices used to estimate inter-rater agreement/consensus and indices used to estimate interrater reliability
  - depending on the aggregation model and the collective constructs, the options may vary

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## THEORETICAL, METHODOLOGICAL AND ANALYTICAL ASPECTS

### analysis in multilevel research

- on the analysis of influences between variables at different levels in multilevel models ...
  - several models and techniques may be used
  - models can be classified in two main groups: conventional multilevel modeling, such as hierarchical linear models (HLM) and more recent and advanced techniques such as multilevel structural equation modeling (MSEM)

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## THEORETICAL, METHODOLOGICAL AND ANALYTICAL ASPECTS

### analysis in multilevel research

- conventional multilevel models were mainly developed for top-down relationships
- the top-down approach that characterizes conventional models assumes that context (higher level variables) exercises greater influence on variables at lower levels than the influence of lower-level variables on context variables
- conventional multilevel modeling has several limitations
  - it cannot model bottom-up effects
  - there are problems with cross-level mediation models

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## THEORETICAL, METHODOLOGICAL AND ANALYTICAL ASPECTS

### analysis in multilevel research

- MSEM overcomes the limitations of conventional multilevel modelling
- advanced multilevel analysis techniques are being developed to examine upward influences and improve the analysis of cross-level mediation
- researchers can use generic software that includes a multilevel research module (e.g., SPSS, MPlus, EQS) and specific multilevel software (e.g., MLwiN and HLM)

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## THEORETICAL, METHODOLOGICAL AND ANALYTICAL ASPECTS

### analysis in multilevel research

- multilevel research can also be conducted using qualitative methodologies
- qualitative methods may be useful and suitable to study the specific mechanisms of emergence processes that help build higher-level concepts, such as human capital from lower-level units, such as individual employees' knowledge, skills and other characteristics
- quantitative and qualitative methods can be combined and integrated in the same multilevel study, using a mixed methods approach

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