ECOLOGICAL SYSTEMS THEORY

Eunhwa Yang and Bonnie Sanborn*

1 Background

Ecological systems theory (EST) was devised by Urie Bronfenbrenner (1979) and explains that human development occurs based upon interactions between a growing human being and their environments. Before EST, researchers mostly focused on the human side of Lewin's equation (Lewin, 1936) that human behaviour was determined by a person's attributes in relation to the environment (see also Chapter 2 Person–Environment Fit Theory). Bronfenbrenner (1979) drew attention to the environmental side with clear categories for and interdependencies between environments and human behaviour. The origin of this theory can be traced to the biological and sociological sciences.

The term *ecology* was brought by Ernst Haeckel (1866), adopting Darwin's (1859) study of the complex interrelationships between organisms and their environments in the process of survival (Stauffer, 1957). In the 1920s, *human ecology* applied the theoretical scheme of plant and animal ecology to human communities (Hawley, 1950). Hawley (1950) claimed that human beings adapted their behaviour patterns for the environments and ecosystems in which they were involved. Changes in behaviour accumulated according to the impact of environmental changes; specifically, changes occurred in order to achieve equilibrium or homeostasis (Hawley, 1950). "The basic premises of ecological theory are that systems are dynamic, change is constant, and everything is connected to everything else" (Salazar & Beaton, 2000, p. 471).

Bronfenbrenner (1979) considers that the development of a person is also driven by dynamic, changing, and connected interactions between a person and social and physical environments in which s/he is involved or not involved but indirectly linked. Bronfenbrenner's EST challenges an approach to human development focused on individual behaviours; it focuses on interconnection and interdependency between systems, emphasizing "examination of multi-person systems not limited to a single setting and must take into account aspects of the environment beyond the immediate situation containing the subject" (Bronfenbrenner, 1979, p. 21). Bronfenbrenner (1979) states that human development is affected by five different layers of environmental systems (see Figure 9.1):

- 1 *Micro-systems*: immediate setting or environment of the person (i.e., home, day care centre, playground, work)

*Corresponding author: eunhwa.yang@design.gatech.edu

Figure 9.1 Bronfenbrenner's ecological systems (1979)

- 2 *Meso-systems*: interrelations between the settings containing the person (i.e., for a child, the relations among home, school, and neighbourhood peers; for an adult, the relations among family, work, and social groups)
- 3 *Exo-systems*: linkages between the environments that do not involve the person but influence the micro-systems (i.e., for a child, the parent's workplace, the parent's network or friends, and the sibling's school and friends; for an adult, the child's school and the spouse's workplace, network, and friends)
- 4 *Macro-systems*: culture and subcultures (i.e., political, economic, cultural, ethnic, religious)
- 5 *Chrono-systems*: time (i.e., human life span, changes in role and setting such as marriage and remarriage, divorce, having a child, and changing jobs)

The five layers are explained within widely understood contexts of child development. The micro-system can be home, school, or community of a child. The child is directly influenced by the immediate environments, such as the relationships with her/his parents, teachers, and friends at school. The meso-system is the relationship between the micro-systems, such as home and school; the parents' attitudes towards the child's teacher affects the child's behaviour at school. The exo-system is the relationships between two or more environments that indirectly influence the developing child. If one parent has a long business trip scheduled, the relationship between the child and the other parent will be changed by activity away from the home. The macro-system of culture and subcultures refers to varying perspectives and social consensus on education and work, which may have effects on child development. Lastly, the chrono-system is the ecological transition resulting from changes in roles or settings and consequent environmental changes. The development of a child is changes with achievement of milestones ordered in time, such as entering school, getting a new job, and getting married.

EST emphasizes the environmental influences and moderating effects of human attributes on corresponding consequences. The theory inspired many social scientists to expand and test it for children and adults evolving throughout their life spans. Bronfenbrenner (1986, p. 287) states,

studies of children and adults in real-life settings, with real-life implications, are now commonplace in the research literature on human development, both in the United

States and, as this volume testifies, in Europe as well. This scientific development is taking place, I believe, not so much because of writings, but rather because the notions I have been promulgating are ideas whose time has come.

2 Applicability to workplace studies

The five main systems in EST emphasize the impact of physical and social environmental factors and their interrelations, including various types of settings in everyday life. Office settings can refer to both physical and social environments; physical environments include office layout, an arrangement of furniture, ergonomic furniture and devices, ambient environments such as temperature, humidity, acoustic, and light, whereas social environments include training or social events at the workplace, and formal and informal interactions with co-workers. The influence of social connections in open-plan offices becomes more frequent and complicated than in enclosed offices, for example, and the design of open-plan offices encourage serendipitous interactions among workers (Oldham & Brass, 1979). Through an EST approach, human relationships and interactions in the workplace can be understood by considering different layers of systems (from micro- to chrono-) within and beyond the office setting.

2.1 A conceptual framework for workplace research based on EST

Workplace strategies and management styles can actually alter different systems of our lives, not just within the system to which the workplace – a micro-system – belongs. Workplace design and strategy influence social and environmental changes within the workplace, workers' perception of and satisfaction with the workplace – but also relationships that workers experience outside of the office, such as their family, their children's development, companies they later work for, and careers. For instance, changes in workplace policy on telecommuting may affect one's family dynamics and activities, emotional ability to socialize, and physical time to socialize. This interconnection of systems, from micro- to chrono-systems, should be considered when planning or measuring workplace strategies and management for comprehensive impact.

Workplace design and strategies can affect individuals' safety (Danna & Griffin, 1999), health (Arundell et al., 2018; Danielsson & Bodin, 2008; Thatcher & Milner, 2014; Wijk, Bergsten, & Hallman, 2020), and environmental perception and satisfaction (Arundell et al., 2018; Brunia, de Been, & van der Voordt, 2016), often highly associated with their job satisfaction (Arundell et al., 2018; Bangwal & Tiwari, 2019; Danielsson & Bodin, 2008). Inadequate environmental support can result in diminished individual productivity (de Been & Beijer, 2014; Thatcher & Milner, 2014). For instance, providing ergonomic furniture and devices can prevent or reduce the risk of an individual's joint problems or chronic muscle fatigue (Robertson & O'Neill, 2003).

Considering the impact of workplace strategies and management on different systems becomes crucial as the boundary of work and individual life becomes blurry. The intertwining of work and life has accelerated along with connectivity, so easily achieved by the internet and mobile technologies and now aggravated through increasing virtual social media connectivity. With this hyperconnectivity, a parent's work can be easily brought into home environments and intervene in family availability and behaviour.

Workplace design and strategies can also affect the process of work, collaborative productivity as a team, and workplace social climate and culture. Similarly, workplace climate and culture affect workplace design and strategy; companies requiring and emphasizing high security and safety practices may design their workplaces with high security and monitoring systems and have

extensive safety training for their employees. These workplace systems and design in turn influence workplace security and safety climate and culture.

Collectively, workplace design and strategies can shape how the communities form through the networks and societal shifts of perception of how the workplace should look or which workplaces are preferred by employees and employers. Lastly, workplace design and strategies can serve different age groups at different periods of their lives, whether in times of physical or cognitive changes, change in marital status, having a child, or changing their jobs.

In this chapter, a simplified conceptual framework based on EST is proposed for previously completed workplace research (Figure 9.2). The framework emphasizes that the impacts of workplace interventions should be measured and analysed across multiple levels/systems (micro-, meso-, exo-, macro-, and chrono-systems), such as individuals, workplace, home, and community, with a longitudinal research design. Applying EST builds a holistic understanding of the impact of workplace interventions and supports theory-driven research.

The following paragraphs explain existing literature; the literature search was limited to studies that explicitly refer to EST. In order to understand how work and workplace affect different dimensions of our lives through the lens of EST, we summarize the literature by subtopics and related outcomes in different ecological levels. Interventions in the workplace can affect (1) *workplace flexibility*, (2) *individual vitality*, (3) *work-family relationships*, (4) *workplace and organizational vitality*, and (5) *community vitality*.

2.2 Workplace flexibility

Workplace flexibility is defined as “the ability of workers to make choices influencing when, where, and for how long they engage in work-related tasks” (Hill et al., 2008a, p. 166). Workplace flexibility is conceptualized as a mediating variable linking individual, home and family, workplace, and community characteristics as explanatory variables to individual, home and family, workplace, and community vitality as dependent variables, based on EST combined with a person–environment fit theory (Hill et al., 2008b). A part of Hill et al.’s (2008b) workplace flexibility framework based on EST, including workplace characteristics, workplace flexibility, and home and family, has been previously tested using a survey in the context of work–life conflict, depending on work hours and schedule flexibility (Hill, Erickson, Holmes, & Ferris, 2010). Hill et al.’s 2010 study found that flexibility in work schedule, work hours, and the choice to work from home all contributed to positive outcomes for employees and the companies they work for. It appears that adding flexibility as a mediating factor allows individuals to use that flexibility to reduce conflict between the differing demands of their multiple contexts and processes, thereby reducing stress. There is a point at which, however, flexibility could not make up for the stress of working longer hours – over 50 hours a week still caused difficulty, despite flexibility and work–from–home options. Interestingly, employees with the option to work from home or flex their schedules were also able to give a few

Figure 9.2 A conceptual framework for workplace research based on ecological systems theory

more hours of productive work per week to their organization, creating a win-win outcome. Differences existed for individuals, especially women, with children at home under the age of 5 – a part of their micro-system – who had a lower ‘break point’ at 41 hours per week of productive work, and for respondents whose cultural context – their macro-system – exerts expectations about physical team presence at the office that cause conflicts which cannot be solved by workplace flexibility. These findings echo Hill’s earlier work showing that gender and presence/age of children both factor into the imbalances in a person’s work-life system, while workplace flexibility options can reduce that stress (Hill et al., 2008a, 2008b).

Skinner and Pocock (2011) also examined the association between flexibility in work hours and work-life interference, which was measured by general interference, work-related time strain with family or friends, work-to-community interference, satisfaction of work-life balance, and time pressure. Like other studies, Skinner and Pocock found that flexible work arrangements reduced work-life interference and slightly increased the productive hours per week an employee was able to work. An interesting outcome of this study was that men tended to request flexibility in their work less often than women did, despite being unhappy with their work arrangements, and of those who did request flexible arrangements the majority were women with children. The authors posit that this may be related to gender norms in their cultural context (macro-system) in which women’s requests for flexibility were understandable given the women are viewed as primary caregivers and in charge of household (micro-system).

2.3 Individual vitality

There has been much theoretical exploration of *individual vitality*, such as employee health and attitudes (Cleveland, Byrne, & Cavanagh, 2015), healthy eating strategies in the workplace (Quintiliani, Poulsen, & Sorensen, 2010), workplace health promotion and well-being management (Bone, 2015), and occupational stress (Salazar & Beaton, 2000). Cleveland et al. (2015) emphasized respect of humanity at work, especially in the human resource management field, and pointed to individuals as the centre of systems (i.e., engagement and well-being, talent acquisition and retention), the relationships between individuals and contexts (human resource communication and leadership, interpersonal relationship, and employee-organization dynamics), and the influence of larger contextual environments (i.e., environmentally sustainable or safe buildings, diversity and legal issues). In Cleveland et al.’s (2015) application of EST in HR systems, multiple level systems included employees, organizational sustainability, and the organization-environment relation, where the latter two systems should support employee health and engagement to develop a human-centred workplace. Quintiliani et al.’s (2010) review paper positioned healthy eating behaviours as a desired outcome, with relevant systems that influence such behavioural choices including individual, organizational and immediate social environments, physical environment settings (i.e., job sites), and macro-level context (i.e., social values and food marketing) (Quintiliani et al., 2010; Story, Kaphingst, Robinson-O’Brien, & Glanz, 2008). Specifically, food availability at work, nutrition labelling, and promotional material at work positively affected employees’ healthy eating behaviours across settings (Story et al., 2008).

Bone (2015) suggested multiple level systems as a theoretical approach to applying EST in workplace health promotion and management: (1) *micro*: workplaces as psychosocial settings and interpersonal relations at work, (2) *meso*: spatial and temporal work-life boundaries, (3) *exo*: governmental policies and codes and other social systems (i.e., federal governmental agencies, healthcare, unions), (4) *macro*: economic, societal, cultural contexts, and (5) *chrono*: time and events. Bone’s (2015) approach was based on the concept of workplaces being a venue of facilitation for health promotion, rather than injury or illness prevention. Salazar and Beaton

(2000) applied EST to understand occupational stresses as an outcome of the interconnection of multisystems. They propose four levels (*micro, organizational, peri-organizational, and extra-organizational systems*) and identify work-related stressors and perceived risk factors for each system level. Salazar and Beaton's (2000) ecological model of occupational stress provided a holistic view of different system levels, including moderating factors (i.e., age, gender, personalities, marital status), outcomes of stress responses, and ultimate health and well-being with detailed work stressors and risk factors. Their ecological occupational stress model can be expanded to understand other dimensions of individual vitality (i.e., performance, positive health outcomes, eating behaviours). All of these theoretical ecological models of workplaces put humans and respect for humanity in the centre of focus and laid out interventions or improvements that can be made at different levels of systems for human health and well-being.

2.4 Work-family relationship

Work-family relationships have been explored theoretically (Wayne, Grzywacz, Carlson, & Kacmar, 2007) as well as through interviews (Grzywacz & Marks, 1999), survey, and observation (Repetti & Wood, 1997). This is a rich area for seeing applications of EST, because work-family relationships are established topics in the fields of family psychology and child development, linking work and family domains and investigating the moderating effects of personal characteristics (Wayne et al., 2007). Commonly addressed dimensions of work factors are organizational climate, social support, workloads, job autonomy, and interpersonal stress (Repetti & Wood, 1997; Voydanoff, 2001).

Wayne et al. (2007) proposed a theoretical framework, the resource-gain-development (RGD) perspective, explaining how work, family, personal characteristics, environmental resources, and demand characteristics are related to work-family facilitation. Wayne et al. (2007, p. 64) defined work-family facilitation as "the extent to which an individual's engagement in one life domain (i.e., work/family) provides gains (i.e., developmental, affective, capital, or efficiency) which contribute to enhanced functioning of another life domain (i.e., family/work)". The RGD perspective emphasized that individual characteristics (i.e., self-efficacy, positive affectivity, work identity) and environmental resources (i.e., developmental opportunities, social support from co-workers and supervisors, family-friendly culture at the workplace) promoted positive employee experience both at work and at home (i.e., work-to-family facilitation).

Grzywacz and Marks (1999) found significant correlations of positive and negative spillover between work and family; for instance, decision latitude was significantly associated with positive work-family interface, both from work to family and from family to work, whereas spouse affectual support was strongly associated with a positive spillover from family to work – but not from work to family. These results confirmed that the work-family interface could be better understood through both work and family domains, not just personal characteristics or role occupations alone (Barnett, Marshall, & Pleck, 1992; Grzywacz & Marks, 1999). Increases in perceived workload and interpersonal stress at work were negatively associated with mother-child interactions in emotion and behaviour; furthermore, mothers who reported more psychological distress (i.e., depression, anxiety) or more Type A behaviour (i.e., time urgency, competition, easy aggression) showed greater parent-child behavioural and emotional withdrawal than those who did not (Repetti & Wood, 1997).

2.5 Workplace and organizational vitality

Workplace and organizational vitality have also been explored theoretically (Allen, Stelzner, & Wielkiewicz, 1999; Chandler, Kram, & Yip, 2011; Johnson, 2011) and empirically in a randomized

controlled true experiment (Cooley, Pedersen, & Mainsbridge, 2014). Theoretical explorations of workplace and organizational vitality include various topics, such as Chandler et al.'s 2011 mentoring at work. Their handbook focuses on the interdependent system of settings in participants' lives, pointing out ways in which a person's mentoring relationships at work impact other multisystems, adding nuances to their application of EST – such as the importance of dyadic exchange in the context of both the workplace micro-system and social network micro-systems. In a similar vein, Allen et al.'s (1999) theoretical approach to leadership points out ways in which leadership must transcend multiple levels if it is to have lasting impact on an organization, society, or global outcomes.

Interventions intended to improve workplace and organizational vitality outcomes have been created based on the idea that relationships and activities within the micro-system (workplace) have an effect on and interdependency with other layers. Cooley et al.'s (2014) study provides an evaluation of a physical-activity-promoting workplace health intervention that resulted in impacts to multiple layers of the ecological system – within the office to beyond the workplace. Participants reported being more aware of their sedentary or active time across settings and changed non-work health habits, including diet and smoking (Cooley et al., 2014). A proposed intervention intended to address and reduce workplace bullying (Johnson, 2011) leverages this same concept in a framework to address the issue within the micro-system (office) while acknowledging ways in which bullying behaviour stems from meso- and exo-system influences, such as attitudes of others and societal stress or norms.

2.6 Community vitality

Community vitality is conceptualized in the context of work and family (Voydanoff, 2001) and workplace violence (Gillespie, Gates, & Fisher, 2015). Work, family, and community are linked to one another; the combination performs a meso-system as a social context (Voydanoff, 2001). In a similar fashion to Johnson's 2011 exploration of a multisystem intervention to address workplace bullying, Voydanoff (2001) points out the systemic interconnectedness of work, family, and community micro-systems and the ways in which actions related to family or work, for example, take place within multiple layers of the system. Acknowledging this reality allows for an approach to community health that takes work into account; employers participate by recognizing the ways in which their workplace micro-system interacts with the community; health and healthy relationships in the home or community space necessarily stem from health and healthy relationships at the office. This is echoed by a review of recommendations for reducing violence and bullying in healthcare workplaces from Gillespie et al. (2015), including a summary of strategies with an EST approach to provide ideas for interventions in individual, relationship, community, and societal levels.

3 Methodology/research approach

3.1 Data collection and analysis

Ecological systems theory has been applied to topics across various disciplines, from workplace culture and community resilience to public policy (Baranowski, Cullen, Nicklas, Thompson, & Baranowski, 2003; Boon, Cottrell, King, Stevenson, & Millar, 2012; Johnson, 2011) with varying methods of research, data collection, and analysis. Some studies take an approach of theoretical exploration, while others focus on quantitative methodology. Data collection and analysis methods differ depending on the topic, but the main objectives of workplace-related studies

are similar: identifying the relationship between work (or work environments) and (behavioural) consequences in the workplace, demonstrating the interconnection of interventions (or environmental factors) and other systems (i.e., family), and showing the influence of work and workplace environments in our lives.

Because EST provides five levels of systems, for data collection and analysis purposes, each system can be analysed separately without considering the other levels of the systems – or multiple systems can be explored simultaneously, to understand interactions and their outcomes. Therefore, it is important to consider the level of study and if it calls for within-level or across-level generalization (Onwuegbuzie, Collins, & Frels, 2013). Within-level generalization refers to generalization made within the same level of the systems (wholly within the workplace). Across-level, on the other hand, means generalization combined with more than two levels of the systems (e.g., between the workplace and the home). Bronfenbrenner and Ceci (1994) developed a person-process-context model to use to propose research methodology for simultaneous investigation (e.g., birth weight, behavioural problems, the quality of infant-mother interaction, social-economic status); with the addition of a chronic system, the model is expanded to a process-person-context-time model (Tudge, Morkova, Hatfield, & Karnik, 2009).

In summary, previous studies applying EST utilize several methods depending on the study objectives (see Table 9.1). Regardless of the level of systems, the most commonly used method is qualitative exploration (Allen et al., 1999; Bone, 2015; Chandler et al., 2011; Cleveland et al., 2015; Gillespie et al., 2015; Hill et al., 2008b; Johnson, 2011; Quintiliani et al., 2010; Salazar & Beaton, 2000; Voydanoff, 2001; Wayne et al., 2007). These studies are theoretical, and most of them explain relationships between factors based on EST. Another set of studies propose new ecological systems based on EST by defining the level of systems according to the topic. Other methods of data collection are surveys (Hill et al., 2010), interviews (Grzywacz & Marks, 1999; Skinner & Pocock, 2011), observation (Repetti & Wood, 1997), and controlled experiment (Cooley et al., 2014); data collected in the quantitative form are analysed using statistical analysis, such as descriptive analysis and regression analysis.

Table 9.1 Data collection and analysis methods: ecological systems theory and workplace studies

<i>Topic</i>	<i>Author(s) & Year</i>	<i>Relevant systems in EST</i>	<i>Data collection and analysis methods</i>
Workplace flexibility	Hill et al., 2010	Meso-system	Survey, statistical analysis (descriptive analysis, ordinary least square (OLS) regression)
	Hill et al., 2008b	Micro-, meso-, exo-, and macro-systems	Theoretical approach, qualitative exploration
	Skinner & Pocock, 2011	Micro- and meso-systems	Telephone interview, statistical analysis
Individual vitality	Cleveland et al., 2015	Micro-, meso-, and exo-systems	Theoretical approach, qualitative exploration
	Quintiliani et al., 2010	Exo- and macro-systems	Theoretical approach, qualitative exploration
	Bone, 2015	Micro-, meso-, exo-, and macro-systems	Theoretical approach, qualitative exploration
	Salazar & Beaton, 2000	Micro-, meso-, exo-, and macro-systems	Theoretical approach, literature review

<i>Topic</i>	<i>Author(s) & Year</i>	<i>Relevant systems in EST</i>	<i>Data collection and analysis methods</i>
Work-family relationship	Grzywacz & Marks, 1999	Micro-system	Interview, statistical analysis (multivariate regression analysis)
	Wayne et al., 2007	Micro- and meso-systems	Theoretical approach, qualitative exploration
	Repetti & Wood, 1997	Meso-system	Observation, statistical analysis (multiple regression)
Workplace and organizational vitality	Cooley et al., 2014	Micro-, meso-, and exo-systems	Controlled experiment
	Chandler et al., 2011	Micro- and macro-systems	Theoretical approach, qualitative exploration
	Allen et al., 1999	Macro-system	Theoretical approach, qualitative exploration
	Johnson, 2011	Multiple systems	Theoretical approach, qualitative exploration
Community vitality	Voydanoff, 2001	Micro-, meso-, and macro-systems	Theoretical approach, qualitative exploration
	Gillespie et al., 2015	Micro-, meso-, exo-, and macro-systems	Theoretical approach, qualitative exploration

3.2 Research gaps in EST inspired workplace research

Table 9.1 shows that there are three main research gaps in workplace studies regarding EST: (1) methodological limitation, (2) lack of integration of multiple levels, and (3) exclusion of built environments.

Most previous studies have focused on theoretical expansion of EST to workplace studies (Cleveland et al., 2015; Gillespie et al., 2015; Hill et al., 2008b; Voydanoff, 2002). Theoretical expansion allows for the adaptation of the theory for various topics related to the workplace but limits the methodology to qualitative exploration based on a literature review. There is a significant shortage of experimental studies using quantitative data (Cooley et al., 2014; Hill et al., 2008a; Törnquist Agosti, Bringsén, & Andersson, 2017) to provide empirical evidence and validate the proposed models.

One of the advantages of EST that it encompasses multisystems and emphasizes interactions between levels. However, multiple levels of EST have not traditionally been tested simultaneously (Chandler et al., 2011; Grzywacz & Marks, 1999), as most studies consider a single system in isolation. Considering multiple levels simultaneously (i.e., hierarchical linear modelling, structural equation modelling) allows testing for interdependence of the social-environmental systems of home, family, school, work, community, culture, and social infrastructures.

Lastly, even though environmental circumstances and surroundings are the key focuses of EST (Bronfenbrenner, 1979), the physical settings of workplace environments have not been fully considered as an environmental system in EST-inspired studies of workplace flexibility and work-family relations. The physical environment of workplaces can affect multisystems to varying degrees, such as individual behaviour, workplace vitality, work-family relationship, and community vitality. Some studies include workplace flexibility in work off-site (i.e., home office) (Hill et al., 2010; Skinner & Pocock, 2011). Additionally, options to select where employees sit at their office with activity-based working and options to select different worksite locations (i.e., company's different locations, third places such as co-working spaces) should be included

in the workplace EST model. In this way, the physical work environment can be tested as an independent, mediating, moderating, or dependent variable in future studies.

4 Limitations

It is challenging to test EST in a real-life context; this difficulty explains the lack of empirical studies in the existing literature. The limitation of applying EST to workplace studies lies in the complexity of dissecting interwoven relationships among different systems. First, measuring the impact of an intervention on different systems can be challenging, as it may require multidisciplinary or transdisciplinary approaches and collaboration among parties with different background knowledge and expertise. For instance, the investigation of an intervention in the physical workplace can be done with the collaboration of employees and their families, designers, facility managers, HR staff, psychologists, and managers from the ecological perspective. Second, the simultaneous measurements in multiple settings require deliberate research plans. The proposed framework in this chapter (see Figure 9.2) can help the process of scrutinizing the effect of workplace strategies and management on multiple levels over time but does not resolve challenges imposed by simultaneous measurements and the difficulty of random assignment, which can limit conclusions of research regarding causality or directionality of relationships. Additionally, the literature search of this chapter is limited to articles that explicitly refer to EST; workplace research that studied similar subjects but did not explicitly refer to or apply EST may be still applicable to the ecological systems of workplaces and even include analogous concepts.

To overcome such challenges, researchers can use quasi-experiments, mixed methods, various statistical modelling techniques (i.e., structural equation modelling, hierarchical linear modelling, factor analysis), and digital media methods. Convergent parallel mixed-methods designs (Creswell & Plano Clark, 2011) and ‘methodological triangulation’ (Bruneel, Wit, Verhoeven, & Elen, 2013) can be used to collect data in parallel strands and connect the results of different methods and multiple level systems. Social media methods, both qualitative and quantitative approaches of analysing user-generated contents on a large scale, have methodological benefits (Dominguez & Hollstein, 2014; Sloan & Quan-Haase, 2017; Snelson, 2016) and also potentially for workplace studies. These limitations also present the possibility that deeper understanding of EST may be gained through alternative research models, including participatory or generative design research.

Ecological systems theory is highly relevant to our personal lives and practices of workplace design, strategies, and management. The theory can be utilized as a tool to understand human behaviour in the workplace and the complex relationships between different dimensions of employees’ lives. The holistic understanding of environmental changes in the workplace, beyond the workplace setting, also highlights the importance of the workplace environment in sustaining the interdependence of micro-, meso-, exo-, macro-, and chrono-systems. As longitudinal measurements in multiple settings require deliberate research plans and coordinated efforts, collaboration between academia and industry is essential to the success of EST-based workplace studies. To this end, professional associations and institutional community outreach centres can play an important role in connecting researchers and practitioners to overcome methodological and logistical challenges, acting as an effective knowledge-sharing and communication platform, and ultimately supporting the achievement of mutual goals.

5 Theory relevance to practice

Workplace managers can benefit from frameworks and interventions rooted in EST by seeing multiple inflection points at which their spatial or programming decisions can benefit employees.

Understanding the underlying mechanics of interconnected systems and the reasons that a multiple level approach to workplace mentoring, wellness, or productivity may bear fruit allows managers to make decisions more effectively.

When asked to consider schedule flexibility, the pros and cons of wellness features offered in leased space, or a request from employees to change workspace or benefits, managers can use the concepts from EST to think through how they might respond to such requests in a way that touches not only the micro-system of the office but also interdependent systems. The benefits of using this approach can be seen in studies from the past 30 years that established stress from the commute can ‘carry over’ into the work day and impact morale and productivity (Costa, Pickup, & Di Martino, 1988; Gottholmseder, Nowotny, Pruckner, & Theurl, 2009; Stutzer & Frey, 2008). Workplace managers reacted. It is now common to consider location relative to where employees live and modes of transit available to get to a potential new office space as a part of leasing criteria – even to consider working to improve transit options to desirable lease locations (Legrain, Eluru, & El-Geneidy, 2015; Wener, Evans, Phillips, & Nadler, 2003).

This relationship between levels is more relevant in a decade that has seen rapid expansion of remote work and work-from-home (WFH) programs; first seen as a way to attract employees through flexibility or enable employees to be more productive when traveling, remote work is now a fact of life for all organizations. Expanding the definition of the workplace to include mobility and amenities within the office, neighbourhood, and city necessitates acknowledging levels of an ecological system explicitly and addressing the ways in which they interact. New issues arise for employees when working remotely, ostensibly as a result of bringing more activities and relationships from one level (the micro-system of the physical workplace) into the mental, physical, social, and virtual spaces of other levels (Vartiainen & Hyrkkänen, 2010).

For example, when an employee is more mobile through system levels and only in the main office a few days a week, they engage in ‘micro-tasking’ while on the go and begin to view the office as a home hub for meetings and longer periods of concentration (Koroma, Hyrkkänen, & Vartiainen, 2014; Vartiainen & Hyrkkänen, 2010). Workplace managers can react to these changing relationships with work outside the office and within it by shifting the amount and types of spaces available to meet shifting needs. For example, an ecosystem of services can be expanded within the community, rather than within the office, in order to keep employees connected to the food, exercise, wellness, and organizational culture that the office formerly provided.

Within the EST, findings from multiple disciplines, such as architecture and design, human development, psychology, environmental psychology, business and management, human resources, construction management, and project management, can be integrated. Having a theory that provides a framework to integrate findings from different fields, which often have their own silos of accumulative knowledge, can provide a holistic view of how workplace research and management affect our lives in the interdependent systems: micro-, meso-, exo-, macro-, and chrono-systems. Moreover, the integration of knowledge from diverse disciplines can foster effective evidence-based practices. In this sense, translational research based on the EST in workplace strategies and management can foster the application of findings from different disciplines into practice.

6 Further reading

- Bone, K. D. (2015). The bioecological model: Applications in holistic workplace well-being management. *International Journal of Workplace Health Management*, 8(4), 256–271. <https://doi.org/10.1108/IJWHM-04-2014-0010>
- Bronfenbrenner, U. (1979). *The ecology of human development: Experiments by nature and Design*. Cambridge, MA: Harvard University Press.

- Hill, E. J., Jacob, J. I., Shannon, L. L., Brennan, R. T., Blanchard, V. L., & Martinengo, G. (2008). Exploring the relationship of workplace flexibility, gender, and life stage to family-to-work conflict, and stress and burnout. *Community, Work & Family*, 11(2), 165–181. <https://doi.org/10.1080/13668800802027564>

7 References

- Allen, K. E., Stelzner, S. P., & Wielkiewicz, R. M. (1999). The ecology of leadership: Adapting to the challenges of a changing world. *Journal of Leadership Studies*, 5(2), 62–82. <https://doi.org/10.1177/107179199900500207>
- Arundell, L., Sudholz, B., Teychenne, M., Salmon, J., Hayward, B., Healy, G. N., & Timperio, A. (2018). The impact of activity based working (ABW) on workplace activity, eating behaviours, productivity, and satisfaction. *International Journal of Environment Research and Public Health*, 15(5), 1005. <https://doi.org/10.3390/ijerph15051005>
- Bangwal, D., & Tiwari, P. (2019). Workplace environment, employee satisfaction and intent to stay. *International Journal of Contemporary Hospitality Management*, 31(1), 268–284. <https://doi.org/10.1108/IJCHM-04-2017-0230>
- Baranowski, T., Cullen, K. W., Nicklas, T., Thompson, D., & Baranowski, J. (2003). Are current health behavioural change models helpful in guiding prevention of weight gain efforts?. *Obesity Research*, 11(S10), 23S–43S. <https://doi.org/10.1038/oby.2003.222>
- Barnett, R. C., Marshall, N. L., & Pleck, J. H. (1992). Men's multiple roles and their relationship to men's psychological distress. *Journal of Marriage and the Family*, 54, 358–367.
- Bone, K. D. (2015). The bioecological model: Applications in holistic workplace well-being management. *International Journal of Workplace Health Management*, 8(4), 256–271. <https://doi.org/10.1108/IJWHM-04-2014-0010>
- Boon, H. J., Cottrell, A., King, D., Stevenson, R. B., & Millar, J. (2012). Bronfenbrenner's bioecological theory for modelling community resilience to natural disasters. *Natural Hazards*, 60(2), 381–408. <https://doi.org/10.1007/s11069-011-0021-4>
- Bronfenbrenner, U. (1979). *The ecology of human development: Experiments by nature and design*. Cambridge, MA: Harvard University Press.
- Bronfenbrenner, U. (1986). Recent advances in research on the ecology of human development. In R. Silbereisen, K. Eyferth, & G. Fudinger (Eds.), *Development as action in context* (pp. 287–309). New York: Springer-Verlag.
- Bronfenbrenner, U., & Ceci, S. J. (1994). Nature–nurture reconceptualized in developmental perspective: A bioecological model. *Psychological Review*, 101(4), 568–586. <https://doi.org/10.1037/0033-295X.101.4.568>
- Brunia, S., de Been, I., & van der Voordt, T. J. M. (2016). Accommodating new ways of working: Lessons from best practices and worst cases. *Journal of Corporate Real Estate*, 18(1), 30–47. <https://doi.org/10.1108/JCRE-10-2015-0028>
- Bruneel, S., Wit, K. D., Verhoeven, J. C., & Elen, J. (2013). Facebook: When education meets privacy. *Interdisciplinary Journal of E-Learning and Learning Objects*, 9, 125–148.
- Chandler, D. E., Kram, K. E., & Yip, J. (2011). An ecological systems perspective on mentoring at work: A review and future prospects. *The Academy of Management Annals*, 5(1), 519–570. <https://doi.org/10.1080/19416520.2011.576087>
- Cleveland, J. N., Byrne, Z. S., & Cavanagh, T. M. (2015). The future of HR is RH: Respect for humanity at work. *Human Resource Management Review*, 25(2), 146–161. <https://doi.org/10.1016/j.hrmr.2015.01.005>
- Cooley, D., Pedersen, S., & Mainsbridge, C. (2014). Assessment of the impact of a workplace intervention to reduce prolonged occupational sitting time. *Qualitative Health Research*, 24(1), 90–101. <https://doi.org/10.1177/1049732313513503>
- Costa, G., Pickup, L., & Di Martino, V. (1988). Commuting: A further stress factor for working people: Evidence from the European Community. I. A review. *International Archives of Occupational and Environmental Health*, 60(5), 371–376. <https://doi.org/10.1007/bf00405673>
- Creswell, J. W., & Plano Clark, V. L. (2011). *Designing and conducting mixed methods research* (2nd ed.). New York: SAGE Publications.
- Danielsson, C. B., & Bodin, L. (2008). Office type in relation to health, well-being, and job satisfaction among employees. *Environment and Behavior*, 40(5), 636–668. <https://doi.org/10.1177/0013916507307459>

- Danna, K., & Griffin, R. W. (1999). Health and well-being in the workplace: A review and synthesis of the literature. *Journal of Management*, 25(3), 357–384. [https://doi.org/10.1016/S0149-2063\(99\)00006-9](https://doi.org/10.1016/S0149-2063(99)00006-9)
- Darwin, C. (1859). *On the origin of species by means of natural selection*. London: Murray.
- De Been, I., & Beijer, M. (2014). The influence of office type on satisfaction and perceived productivity support. *Journal of Facility Management*, 12(2), 142–157. <https://doi.org/10.1108/JFM-02-2013-0011>
- Dominguez, S., & Hollstein, B. (Eds.). (2014). *Mixed methods social networks research: Design and applications*. Cambridge: Cambridge University Press.
- Gillespie, G. L., Gates, D. M., & Fisher, B. S. (2015). Individual, relationship, workplace, and societal recommendations for addressing healthcare workplace violence. *Work*, 51(1), 67–71. <https://doi.org/10.3233/WOR-141890>
- Gottholmseder, G., Nowotny, K., Pruckner, G. J., & Theurl, E. (2009). Stress perception and commuting. *Health Economics*, 18(5), 559–576. <https://doi.org/10.1002/hec.1389>
- Grzywacz, J. G., & Marks, N. F. (1999). Family solidarity and health behaviours: Evidence from the National Survey of Midlife Development in the United States. *Journal of Family Issues*, 20(2), 243–268. <https://doi.org/10.1177/019251399020002004>
- Haeckel, E. (1866). *Generelle Morphologie der Organismen – Allgemeine Grundzüge der organischen Formen-Wissenschaft, mechanisch begründet durch die von Charles Darwin reformierte Descendenz-Theorie*. Zweiter Band: Allgemeine Entwicklungsgeschichte der Organismen. Berlin: Verlag von Georg Reimer.
- Hawley, A. H. (1950). *Human ecology: A theory of community structure*. New York: Ronald Press Company.
- Hill, E. J., Erickson, J. J., Holmes, E. K., & Ferris, M. (2010). Workplace flexibility, work hours, and work-life conflict: Finding an extra day or two. *Journal of Family Psychology*, 24(3), 349–358. <https://doi.org/10.1037/a0019282>
- Hill, E. J., Grzywacz, J. G., Allen, S., Blanchard, V. L., Matz-Costa, C., Shulkin, S., & Pitt-Catsoupes, M. (2008b). Defining and conceptualizing workplace flexibility. *Community, Work & Family*, 11(2), 149–163. <https://doi.org/10.1080/13668800802024678>
- Hill, E. J., Jacob, J. I., Shannon, L. L., Brennan, R. T., Blanchard, V. L., & Martinengo, G. (2008a). Exploring the relationship of workplace flexibility, gender, and life stage to family-to-work conflict, and stress and burnout. *Community, Work & Family*, 11(2), 165–181. <https://doi.org/10.1080/13668800802027564>
- Johnson, S. L. (2011). An ecological model of workplace bullying: A guide for intervention and research. *Nursing Forum*, 46(2), 55–63. <https://doi.org/10.1111/j.1744-6198.2011.00213.x>
- Koroma, J., Hyrkkänen, U., & Vartiainen, M. (2014). Looking for people, places and connections: Hindrances when working in multiple locations: A review. *New Technology, Work and Employment*, 29(2), 139–159. <https://doi.org/10.1111/ntwe.12030>
- Legrain, A., Eluru, N., & El-Geneidy, A. M. (2015). Am stressed, must travel: The relationship between mode choice and commuting stress. *Transportation Research Part F: Traffic Psychology and Behaviour*, 34, 141–151. <https://doi.org/10.1016/j.trf.2015.08.001>
- Lewin, K. (1936). *Principles of topological psychology*. New York: McGraw-Hill.
- Oldham, G. R., & Brass, D. J. (1979). Employee reactions to an open-plan office: A naturally occurring quasi-experiment. *Administrative Science Quarterly*, 24(2), 267–284. <https://doi.org/10.2307/2392497>
- Onwuegbuzie, A. J., Collins, K. M., & Frels, R. K. (2013). Foreword: Using Bronfenbrenner's ecological systems theory to frame quantitative, qualitative, and mixed research. *International Journal of Multiple Research Approaches*, 7(1), 2–8. <https://doi.org/10.5172/mra.2013.7.1.2>
- Quintiliani, L., Poulsen, S., & Sorensen, G. (2010). Healthy eating strategies in the workplace. *International Journal of Workplace Health Management*, 3(3), 182–196. <https://doi.org/10.1108/17538351011078929>
- Repetti, R. L., & Wood, J. (1997). Effects of daily stress at work on mothers' interactions with preschoolers. *Journal of Family Psychology*, 11(1), 90–108. <https://doi.org/10.1037/0893-3200.11.1.90>
- Robertson, M. M., & O'Neill, M. J. (2003). Reducing musculoskeletal discomfort: Effects of an office ergonomics workplace and training intervention. *International Journal of Occupational Safety and Ergonomics*, 9(4), 491–502. <https://doi.org/10.1080/10803548.2003.11076585>
- Salazar, M. K., & Beaton, R. (2000). Ecological model of occupational stress: Application to urban fire-fighters. *Workplace Health & Safety*, 48(10), 470–479.
- Skinner, N., & Pocock, B. (2011). Flexibility and work-life interference in Australia. *Journal of Industrial Relations*, 53(1), 65–82. <https://doi.org/10.1177/0022185610390297>
- Sloan, L., & Quan-Haase, A. (Eds.). (2017). *The SAGE handbook of social media research methods*. London: SAGE Publications.
- Snelson, C. L. (2016). Qualitative and mixed methods social media research: A review of the literature. *International Journal of Qualitative Methods*, 15(1). <https://doi.org/10.1177/1609406915624574>

- Stauffer, R. C. (1957). Haeckel, Darwin, and ecology. *The Quarterly Review of Biology*, 32(2), 138–144. <https://doi.org/10.1086/401754>
- Story, M., Kaphingst, K. M., Robinson-O'Brien, R., & Glanz, K. (2008). Creating healthy food and eating environments: Policy and environmental approaches. *Annual Reviews of Public Health*, 29, 253–272. <https://doi.org/10.1146/annurev.publhealth.29.020907.090926>
- Stutzer, A., & Frey, B. S. (2008). Stress that doesn't pay: The commuting paradox. *The Scandinavian Journal of Economics*, 110(2), 339–366. <https://doi.org/10.1111/j.1467-9442.2008.00542.x>
- Thatcher, A., & Milner, K. (2014). Changes in productivity, psychological wellbeing and physical wellbeing from working in a 'green' building. *Work*, 49(3), 381–393. <https://doi.org/10.3233/WOR-141876>
- Törnquist Agosti, M., Bringsén, Å., & Andersson, I. (2017). The complexity of resources related to work-life balance and well-being: A survey among municipality employees in Sweden. *The International Journal of Human Resource Management*, 28(16), 2351–2374. <https://doi.org/10.1080/09585192.2017.1340323>
- Tudge, J., Morkova, I., Hatfield, B. E., & Karnik, R. B. (2009). Uses and misuses of Bronfenbrenner's bioecological theory of human development. *Journal of Family Theory & Review*, 1(4), 198–210. <https://doi.org/10.1111/j.1756-2589.2009.00026.x>
- Vartiainen, M., & Hyrkkänen, U. (2010). Changing requirements and mental workload factors in mobile multi-locational work. *New Technology, Work and Employment*, 25(2), 117–135. <https://doi.org/10.1111/j.1468-005X.2010.00243.x>
- Voydanoff, P. (2001). Conceptualizing community in the context of work and family. *Community, Work & Family*, 4(2), 133–156. <https://doi.org/10.1080/713658928>
- Voydanoff, P. (2002). Linkages between the work-family interface and work, family, and individual outcomes: An integrative model. *Journal of Family Issues*, 23(1), 138–164. <https://doi.org/10.1177/0192513X02023001007>
- Wayne, J. H., Grzywacz, J. G., Carlson, D. S., & Kacmar, K. M. (2007). Work-family facilitation: A theoretical explanation and model of primary antecedents and consequences. *Human Resource Management Review*, 17(1), 63–76. <https://doi.org/10.1016/j.hrmr.2007.01.002>
- Wener, R. E., Evans, G. W., Phillips, D., & Nadler, N. (2003). Running for the 7:45: The effects of public transit improvements on commuter stress. *Transportation*, 30(2), 203–220. <https://doi.org/10.1023/A:1022516221808>
- Wijk, K., Bergsten, E. L., & Hallman, D. M. (2020). Sense of coherence, health, well-being, and work satisfaction before and after implementing activity-based workplaces. *International Journal of Environmental Research and Public Health*, 17(14), 5250. <https://doi.org/10.3390/ijerph17145250>