# Operationalizing Bronfenbrenner's PPCT Model in Researching Human Development: Commentary on Xia, Li and Tudge

Iram Siraj & Runke Huang

Department of Education

University of Oxford

UK

Correspondence iram.siraj@education.ox.ac.uk

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## Overview

Bioecological theory has been widely used and discussed in human development (especially child development) research (e.g., Jaeger, 2016; Siraj & Mayo, 2014; Tudge et al., 2009). However, considering the complexity of the bioecological theory, it is not surprising that researchers would misinterpret its use or apply it as an analytical framework. The debate on how to apply this theory and the appropriateness of its operationalisation continues. In the article 'Operationalizing Urie Bronfenbrenner's Process-Person-Context-Time model', Xia, Li and Tudge (this issue) explore the central question of how to apply Bronfenbrenner's Process-Person-Context-Time (PPCT) model in research. To answer this question, they provide theoretical clarifications to some previously less transparent aspects of the PPCT model, examples of how to apply different elements of PPCT model in research, the caution of synergistic relations among each of the four dimensions, and the ways to reduce complexity in applying the PPCT model. Urie Bronfenbrenner himself failed to be explicit about its operationalisation in designing and conducting research and sadly died in 2005 before the work was exemplified.

Different from previous studies that use the bioecological model (often) as an analytical tool or framework to investigate the impacts of Process-, Person-, Context-, and Time-level factors on human development; Xia, Li and Tudge (this issue) provide another important and engaging perspective—using the PPCT model at the outset of designing a research study or program. The article provides theoretical insight and practical guidance to operationalise the PPCT model by identifying the developmental outcome of interest and the most related proximal process, exploring personal and contextual characteristics, and collecting data over time, claiming that at the same time, with the whole PPCT model in mind, researchers can potentially design individually, contextually, and historically sensitive research.

There are other benefits to their article. First, it adopts a broader perspective for considering both Competence- and Dysfunction- outcomes in research. Second, this article points out that the same variables cannot coexist in different elements, especially when we explore teacher-child interactions, which involve two persons. Third, life transitions that involve biological and social transition in human life-course would change an individual's developmental trajectory (Bronfenbrenner, 1999), which allows researchers to conduct within-subject research designs across different times. Overall, this article is a helpful addition to correct the current narrow use of the PPCT model, to provide broader perspectives for using the PPCT model to guide research designs, and to help us reflect on the limitations of research and find further research directions. We are grateful to Xia, Li and Tudge for their insights. In this commentary, we will be summarising their main points and contributions and further discussing how the bioecological theory or PPCT model can be employed as the foundation of some research.

## Operationalizing the PPCT Model

### Bioecological Theory and the PPCT Model

#### *Contextualist Paradigm*

Applying models and theories require researchers to understand the underlying developmental mechanism and explicate the key concepts that are incorporated into empirical research (Siraj & Mayo, 2014). Xia, Li and Tudge (this issue) start their work by indicating the paradigm. They state that Bronfenbrenner's bioecological theory fits within the contextualist paradigm of human development, thus requiring contextualist approaches. Contextualist approaches emphasise that environment, developing individuals, and developmental processes are intertwined and that neither the environment nor the individual competencies can explain development alone (Siraj & Mayo, 2014). Bronfenbrenner’s works combine genetic inheritance and the contrasting environment. They cross borders from

psychology to social science and integrate both social and psychological perspectives of human development (Siraj & Mayo, 2014). Accordingly, we cannot explore developmental trajectories without simultaneously considering the interpersonal and environmental aspects that contribute to the development process.

### *Two Distinct Periods*

Based on the contextualist paradigm, Bronfenbrenner's works about the connectivity of life consist of two distinct periods. The initial bioecological theory termed as the ecological approach (1973–1979) which focused on the role of the social contexts (i.e., four systems) in shaping individual development, culminated in the publication of *The Ecology of Human Development* (1979), while the present bioecological theory emphasises the individual's role and the proximal processes (Siraj & Mayo, 2014). According to bioecological theory, researchers should investigate one's characteristics, the settings in which individuals interact with others and spend time, and the proximal process that serves as the key "engines of development" (Bronfenbrenner & Morris, 2006, p. 822). However, as indicated in the article by Xia, Li and Tudge (this issue), the changes might be overlooked by some researchers, resulting in misuse. Furthermore, testing the bioecological theory requires an adequate research design; Bronfenbrenner with his colleague Morris constructed the PPCT model, which focuses on the proximal process and the interactions between proximal processes and Person and Context over Time. After clarifying the contextualist approach and two evolutional periods, the article clearly defines four properties of PPCT models, demonstrates how to incorporate these four properties in research, and provides practical guidelines for (helpfully) simplifying the PPCT.

## Four Properties of the PPCT Model

### *Process*

In the bioecological theory, Bronfenbrenner emphasised the individual's role in development and regarded proximal processes as the core of this theory as well as the generator of development (Bronfenbrenner, 1994). Interestingly, this article notes the contrast: if the proximal processes serve as "engines of development," what distinguishes the proximal process leading to *Competence* or *Dysfunction*? According to Bronfenbrenner and Evan (2000), the impact of proximal processes might produce two types of developmental outcomes: manifestations of difficulties or disadvantaged environment lead to Dysfunction, while advantaged and stable environments result in Competence. Based on this question, the article takes a broader perspective and considers both factors which would lead to Competence or Dysfunction to explore the outcomes. In contrast to this, Siraj and Mayo (2014) provide another possibility to strengthen an individual's Competence through making the interactional processes progressively more complicated, such as providing developmentally and culturally appropriate resources, instructions, and interaction. This perspective aligns with Bronfenbrenner and Morris's (2006) work since they believed that parents' engagement in proximal processes could help to reduce Dysfunction after they become aware of the disadvantaged environments of their children.

***Person***

Person characteristics that both drive and result from future development consist of force (i.e., behavioural dispositions), resource (i.e., experience, ability, knowledge, and materials), and demand (i.e., personal stimulus). This property shows a good combination of psychology and social science in Bronfenbrenner's work. The authors' way to operationalise Person characteristics aligns with Tudge and his colleagues' recommendations in 2009 (e.g., Tudge et al., 2009): to select one or two Person characteristics. To simplify the Person-level variables in research, the authors further note it is possible to ignore children's characteristics and only focus on teachers' characteristics. Here is where we need caution. Different from

Bronfenbrenner's earlier works, which focus more on contextual influences on development, the PPCT model places proximal processes or, in other words, the context–individual interaction, at the heart. The proximal process of children's English learning in the article is defined as teacher–child interaction. Accordingly, there are two persons involved, instead of regarding children as the developing individual and putting teachers' characteristics in the microsystem, as indicated by Bronfenbrenner's earlier works (e.g., Bronfenbrenner, 1979). However, it's less clear in this article how it was decided which person to include and why only teachers' characteristics are included. Especially considering the synergistic and bidirectional interrelationships within the model, surely children's characteristics would also influence teachers' responses and behaviours. The authors provide a practical way to make the operationalisation manageable. Although the article is immensely helpful in beginning a dialogue amongst researchers interested in bioecological theory, further clarification and testing of the operationalisation of PPCT model would be helpful.

***Context***

What we find deserves more attention is the potential overlap between Person-level variables and Context-level variables (e.g., book resource and classroom characteristics in this study). The authors point out this possibility and state that the same variables could not coexist in both levels. Examining other levels of Context or identifying relevant aspects in other microsystems might be a practical solution. Different from Tudge et al. (2009) and Jaeger (2016), who suggest including at least two microsystems or macrosystems when operationalising the PPCT model, this article recommends including at least one aspect of Context. As mentioned above, further explanation and clarification might be needed for ongoing discussion.

***Time***

Similar to the contextual system, Time also involves three types (i.e., Microtime, Mesotime and Macrotime; Bronfenbrenner & Morris, 2006). Although longitudinal studies could be favourable when we employ the PPCT model, this article suggests alternative ways to collect longitudinal data such as using questionnaires and interviews to explore the duration and frequency of the occurrence of the proximal process. Interestingly, the authors go further to point out the ecological transition, which involves changes in Person characteristics (e.g., puberty) and in Context (e.g., starting preschool). Bronfenbrenner (1999) indicated the concept of *life transition* in the second principle of Elder's life-course theory (1998), which is called timing in lives. The transitions or early versus late arrivals of transitions play an essential role in proximal processes and human development. Take children's transition to primary school in the United Kingdom, for instance, children born in autumn tend to have better academic performance than their younger summer-born classmates, as they might be almost a year older, since most children start primary reception in September (Siraj & Mayo, 2014). We noted that life transition provides new possibilities in applying the PPCT model. As the authors suggest, within-subject variables can be incorporated in research to explore the influence of changes in Person and Context characteristics on human development or to make some changes (i.e., intervention) for better developmental outcomes.

**The Synergistic Interrelationships**

This section clarifies important but less transparent aspects regarding synergistic interrelationships among or within the components of the PPCT model. Xia, Li and Tudge (this issue) indicate that developmental outcomes would also bring synergistic influences on the components of the PPCT model. For instance, higher self-efficacy would also influence students' diligent practice. The overlooking of the synergistic and bidirectional interrelationship was pointed out by Bronfenbrenner and Morris in 2006 regarding Drillien's

study. However, the synergistic interrelationship remains little explored in empirical research. This article further distinguishes research designs with weak synergy from those with strong synergy. The former focuses on the unidirectional effects within the components of PPCT or the effects of the components of the PPCT model on developmental outcomes, while the latter requires the examination the bidirectional relationships. Due to the complexity of incorporating strong synergy into research, this manuscript suggests the possibility to employ cross-lagged designs, which allow the values of variables at Time 1 to predict their measured values at Time 2.

## General Discussion

Researchers in the field of human development would like to incorporate the bioecological theory or PPCT model in their research to explain developmental processes (e.g., Jaeger, 2016; Rosa, & Tudge, 2013; Siraj & Mayo, 2014). However, since 2009, only two of the twenty published papers described, analysed, and tested some or all elements of the PPCT model appropriately (Tudge et al., 2016). Then here comes the question which keeps being discussed: “what does it exactly mean to employ bioecological theory as the foundation of research?” This article employs a theoretically driven perspective. That is, to construct research designs following the PPCT map.

Furthermore, we can see two possibilities, as played out by Xia, Li and Tudge (this issue). The first is to construct a relatively comprehensive research design to test the model, such as choosing children’s English learning efficacy as the development of interest, focusing on teacher–student interactions as the most relevant proximal process, emphasizing classroom characteristics as the microsystem, social beliefs of English learning as the macrosystem, and collecting data over time. As indicated by Bronfenbrenner and Morris (2006), the present value of the PPCT model lies in its rarity instead of its scientific power. It is still an evolutionary theory that needs to be used and tested before we can see the full value

of it. It needs to be operationalised in a more sophisticated way which the authors advance. In this regard, this article does provide us with the possibility of incorporating the four dimensions into research for testing, questioning, expanding, and supporting the existing theory.

The second possibility lies in treating the PPCT model at the outset of the research plan for designing individually-, contextually-, and historically sensitive research. What we find exciting is that the authors take the PPCT model into account from the beginning of their research, and PPCT awareness keeps guiding the whole research design, including the analytical framework. Researchers consider what precisely the development of interest is, what is the essential proximal process, which system they would like to explore, and when they need to collect data. Even if not all of the dimensions and their sub-elements can be examined in one research study, the whole model can help us compare and decide which aspects or sub-elements are essential to be included in a study. It can also act as an analytical framework to help us evaluate our research designs, to think about the limitations of our studies, and to consider desirable aspects that deserve further investigation.

One thing we consider that is less explicitly explored in this article is whether there are aspects of PPCT that are essential in every study and aspects that are optional. Considering the complexity of the PPCT model, the article states that there is no need to include all dimensions, sub-elements and the synergistic interrelationships in a single research study. We also noted that this article selects relevant variables in each element and suggests starting from constructing a PPC or PPT model. However, it does not clarify what aspects and how many aspects are necessary and which might be desirable or optional. Tudge and his colleagues (2009) provide a standard that involves at least one proximal process and two of the following aspects: (1) person characteristics; (2) at least two micro- or macro-systems; and (3) longitudinal data collection. Jaeger (2017) goes beyond this to emphasise

the interactions between the proximal process and two of the aspects mentioned above. Both of them regard the characteristics of the proximal process as essential elements. This article adds to the current discussion of theoretical operationalisation of the PPCT model by distinguishing necessary and desirable elements.

## Conclusion

Bronfenbrenner's bioecological theory integrates psychological perspective and social-contextual/cultural perspectives of human development and provides a holistic model. To some extent, it encourages mixed-methods research, which can help us explore complex social phenomena and obtain more comprehensive inferences and meta-inferences because of its transdisciplinary perspective. The article makes a useful point that quantitative data analysis (e.g., Structural Equation Modelling) can explore the nested models. At the same time, any qualitative analysis also needs consideration since it can help us further understand complex social phenomena profoundly and contextually.

The PPCT model also gives us a holistic framework through which to evaluate the strengths and limitations of perspectives within a study. It can be considered from the beginning of research to guide the whole research design, make the research contextually sensitive, act as an analytical model for process evaluation, and provide direction for further research. Xia, Li and Tudge (this issue) provide an immensely helpful rationale to incorporate PPCT awareness for better research designs and to construct relatively complete research to test the model. At the same time, we have to bear in mind that any theoretical framework can only tell us what elements might function on human development, instead of specifying the relations among the variables (Rosa & Tudge, 2013). The evolutionary nature of theory calls for our attention to specify it accurately, be aware of the changes, and construct sensitive research to test and expand it. As claimed by Bronfenbrenner and Morris (2006), "We are dealing with science in the discovery mode rather than in the mode of verification" (p. 801).

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