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Achieving Optimal Best: A Focus of Inquiry from the
Perspective of Cognitive Load Imposition

A/Prof. Huy P. Phan & Dr. Bing H. Ngu

August, 2018



Optimal Best Practice: Introduction

A question that we often see is this:

“What is my personal best?”

Personal best is concerned with the maximization of a person’s state of functioning.

Personal best reflects the *paradigm of positive psychology* (Seligman & Csikszentmihalyi, 2000) for its emphasis on the following:

- A state of flourishing and proactive engagement.
- Inner mental strength and personal resolute.
- Positive outlook

Optimal Best Practice: Query for Consideration

One interesting question for development: *how does a person achieve personal best?* For example, academically, how does a student achieve optimal cognitive functioning?

In Education, health, psychology, and sports, researchers often use the term ‘optimization’ – for example, “we need to optimize his performance.....”

Basically, personal best is closely aligned with optimization.

We recently explored this process of optimization by proposing a theoretical positioning, which we coined as the *Framework of Achievement Bests* (e.g., Phan, Ngu, & Williams, 2016; Phan, Ngu, & Yeung, 2017).

The Framework of Achievement Bests

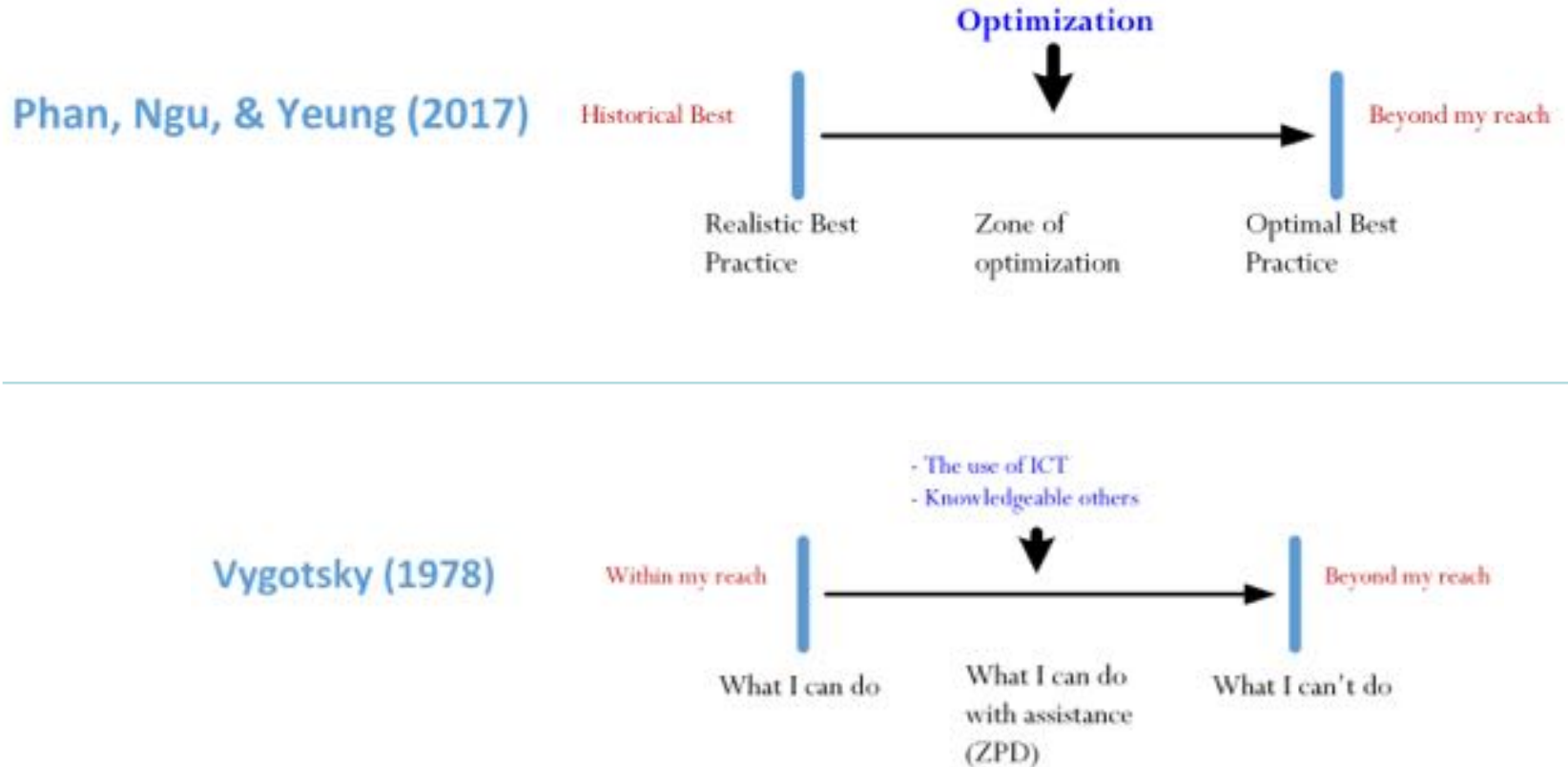


Figure 1: The Framework of Achievement Bests.

Process of Optimization (Phan, Ngu, & Yeung, 2017)

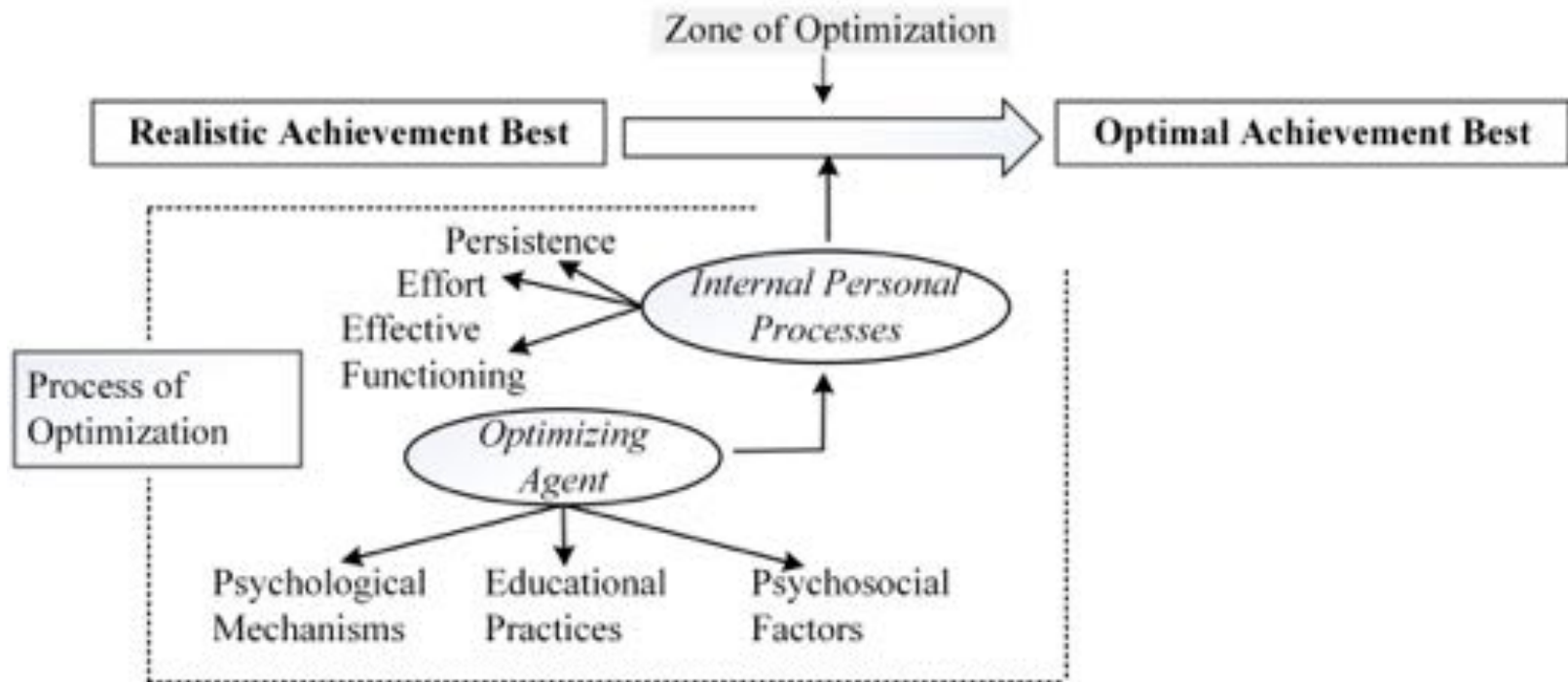


Figure 2: The Framework of Achievement Bests (Phan, Ngu, & Yeung, 2017).

Conceptualization of the Process of Optimization



Process of Optimization (Phan & Ngu, 2017)

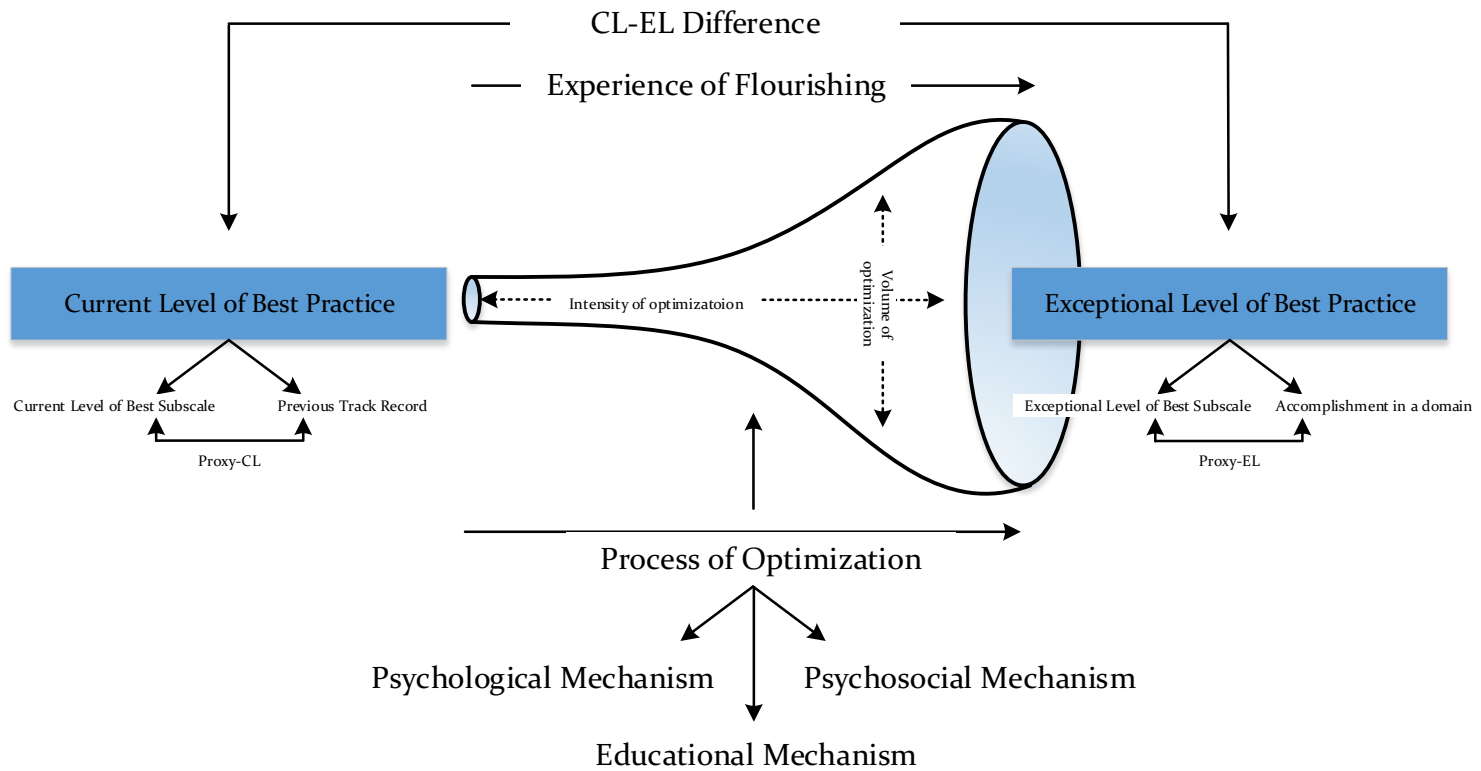


Figure 3: The Framework of Achievement Bests (Phan & Ngu, 2017).

Process of Optimization (Phan & Ngu, 2018)

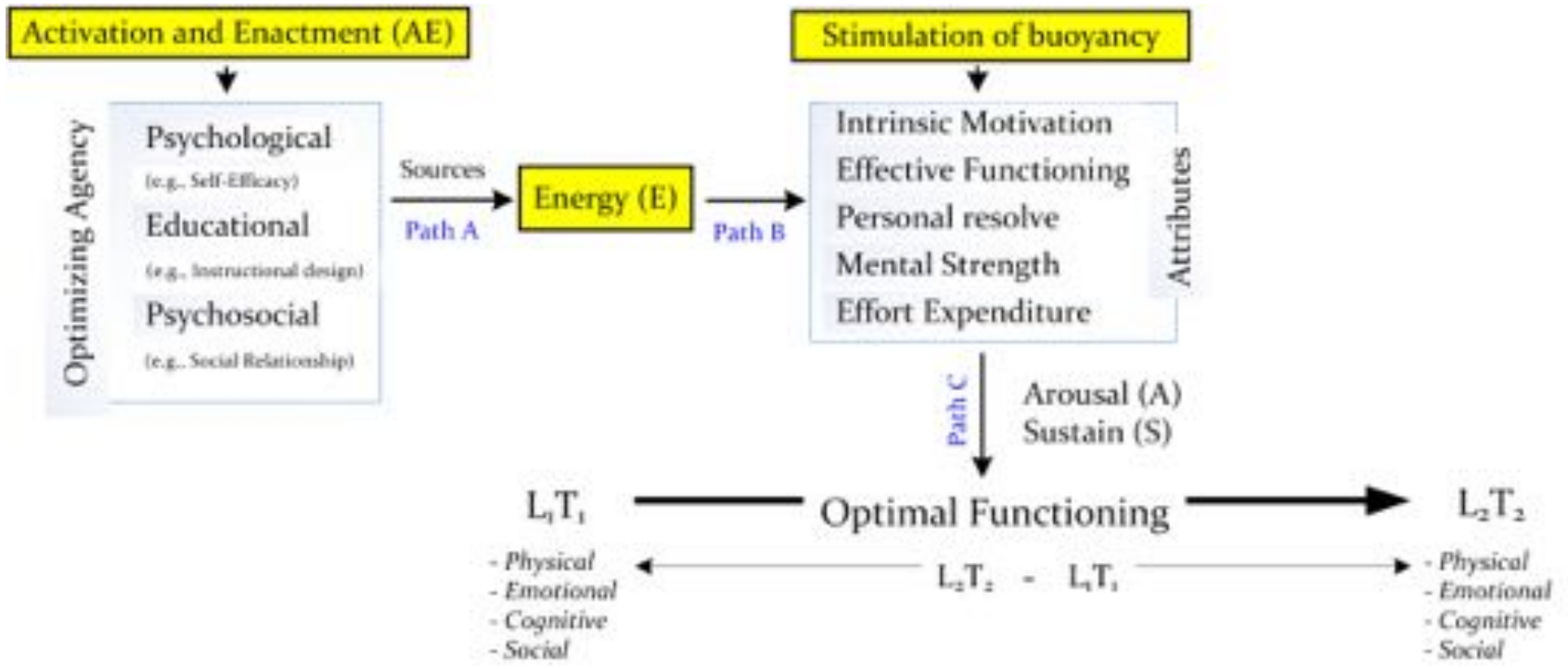


Figure 4: The Process of Optimization (Phan, Wang, Shih, Shi, Lin, & Ngu, 2018).

Optimizing Agencies

Our development (e.g., Phan & Ngu, 2018; Phan et al., 2017) stipulates different agencies that could serve to optimize a person's state of functioning.

One educational agency in academic learning is that of instructional designs, which may closely align with *cognitive load imposition* (Sweller, 2012; Sweller, Ayres, & Kalyuga, 2011). What is cognitive load imposition?

Cognitive load consists of three different types:

1. *Extraneous cognitive load: inappropriate instructional design*
2. *Intrinsic load: inherent complexity of the task/material*
3. *Germane load: cognitive resources directed to learn the schema*

Source: Sweller, 2010; 2011; 2012; Sweller, van Merriënboer & Paas, 1998; van Merriënboer & Sweller, 2005.

Element Interactivity and Cognitive Load Theory

Element interactivity is a common factor for both extraneous and intrinsic loads.

- Intrinsic cognitive load is imposed by the element interactivity of the task. It also depends on the learners' expertise in the domain.
- Extraneous cognitive load is imposed by the element interactivity arising from inappropriate instructional design.
- Germane load does not represent an independent source of cognitive load; it refers to cognitive resources directed to learn the element interactivity of the task.

Research on Element Interactivity

Our own research (e.g., see below) has involved examination of the following inquiries:

1. Low element interactivity task (e.g., learn to recognize individual numbers, 4 or 11).
2. High element interactivity task, (e.g., learn solve this equation, $9 - 11 = -2$).

Source:

1. Ngu, B. H., & Phan, H. P. (2016). Unpacking the complexity of linear equations from a cognitive load theory perspective. *Educational Psychology Review*, 28, 95-118.
2. Ngu, B. H., & Phan, H. P. (2017). Will learning to solve one-step equations pose a challenge to 8th grade students? *International Journal of Mathematical Education in Science and Technology*, 48(6), 876-894.
3. Ngu, B. H., Yeung, A. S., Phan, H. P., Hong, K. S., & Usop, H. (2018). Learning to solve challenging percentage-change problems: A cross-cultural study from a Cognitive Load Perspective. *Journal of Experimental Education*, 86(3), 362-385. doi:10.1080/00220973.2017.1347774

Cognitive Load and Optimal Best

So overall, how does cognitive load associate with optimal best?

An instructional design that has a low level of element interactivity and therefore low cognitive load imposition would correspond with optimal best achievement in mathematics.

For example, what would be an effective instruction that will impose low cognitive load for learning percentage problem such as:

I spent 8% of my money on a new graphite tennis racquet, which costs \$108. How much money did I have before the purchase?"

The Unitary Approach

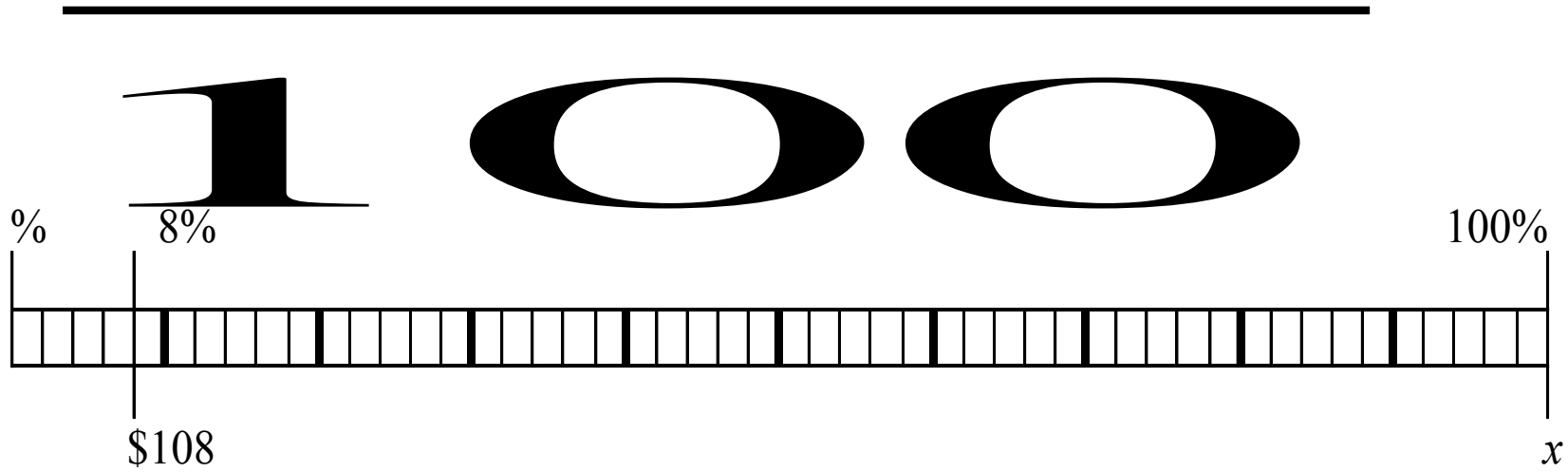
For example, the steps involved in the unitary approach are shown below (McSeveny et al., 2004, p. 76) :

<i>Step 1</i>		8% of my money = \$108
<i>Step 2</i>	\therefore 1% of my money	$\$108 \div 8 = \13.50
<i>Step 3</i>	\therefore 100% of my money	$\$13.50 \times 100 = \1350

Would this Unitary Approach be effective?

The Equation-Pictorial Approach

x



Other Instructional Designs for Consideration

There are other instructional designs, non-mathematics, that we could use to facilitate achievement of optimal best.

In particular, consider two fundamental examples:

1. The Redundancy Effect
2. The Split Attention Effect

The Redundancy Effect

Figure 10.7 Information regarding food sales on Fridays.

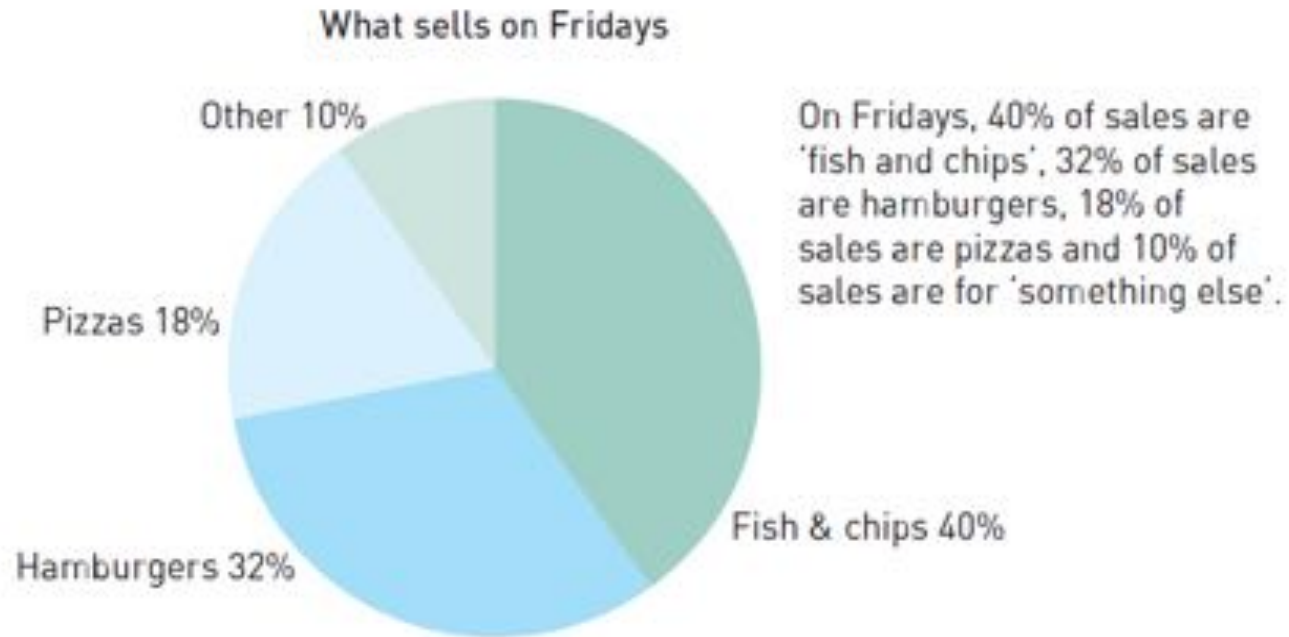


Figure 5: The Redundancy Effect.

Source: Phan, H. P., & Ngu, B. H. (2018). *Teaching, Learning and Psychology*. South Melbourne, Victoria: Oxford University Press.

The Split Attention Effect

Figure 10.5(a) Split-source format—Chinese characters problem.

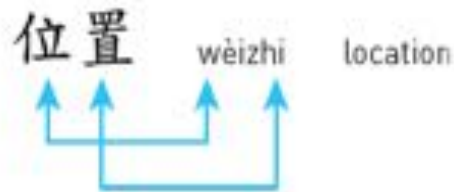


Figure 10.5(b) Integrated format—Chinese characters problem.



Figure 6: The Split Attention Effect.

Source: Phan, H. P., & Ngu, B. H. (2018). *Teaching, Learning and Psychology*. South Melbourne, Victoria: Oxford University Press.

Cognitive Load and Achievement Bests: In Totality

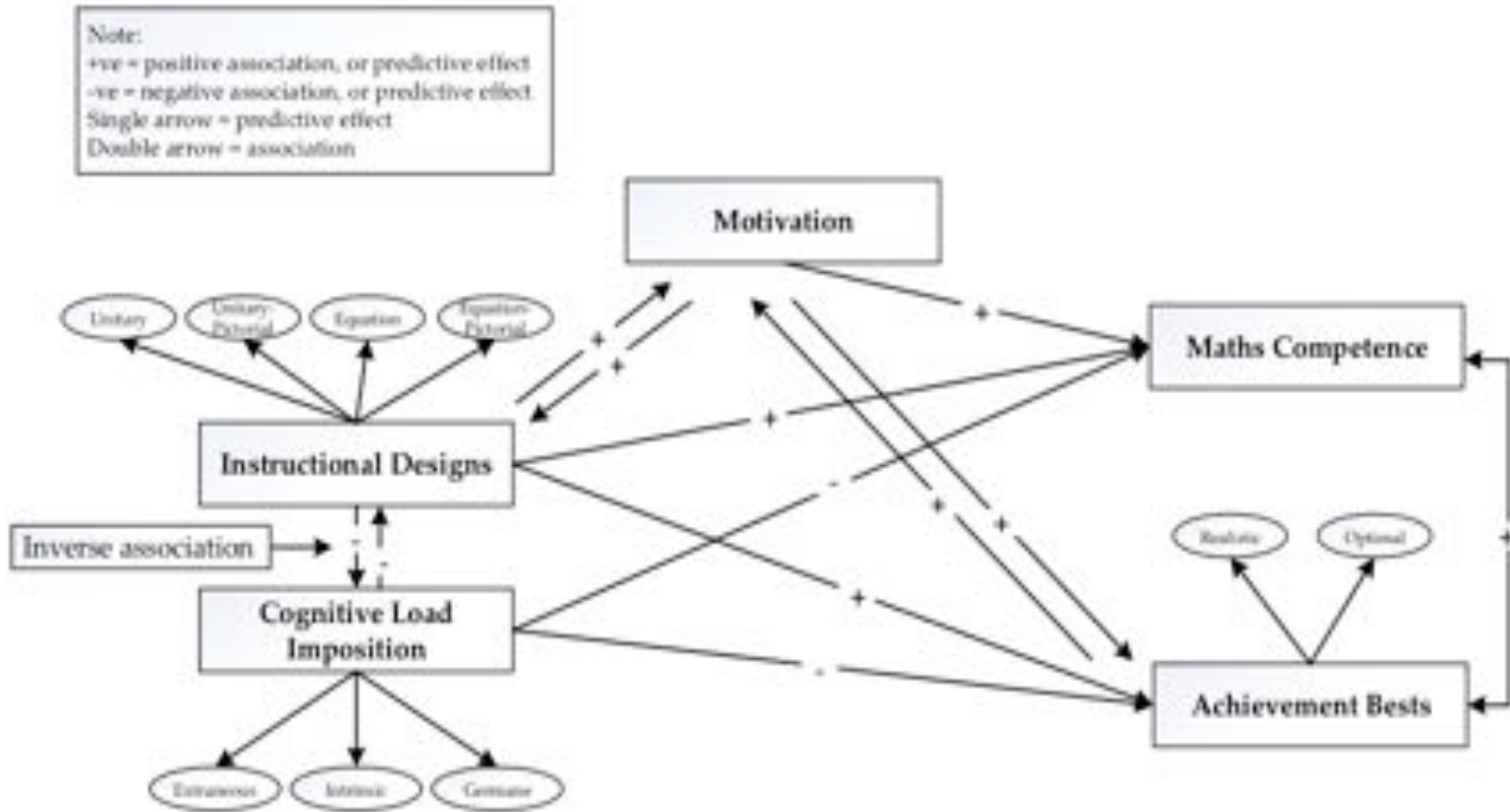


Figure 7: Instructional Designs, Cognitive Load Imposition, Motivation, Achievement Bests, and Mathematics Competence.

Source: Phan, Ngu, & Yeung, 2017).

References

Selected references:

1. Ngu, B. H., & Phan, H. P. (2016). Unpacking the complexity of linear equations from a cognitive load theory perspective. *Educational Psychology Review*, 28, 95-118.
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8. Phan, H. P., Wang, H.-W., Shih, J.-H., Shi, S.-Y., Lin, R.-Y., & Ngu, B. H. (2018). The importance of mindfulness in the achievement of optimal best: Conceptualization for research development. In V. Trif (Ed.), *Educational Psychology - Between certitudes and uncertainties*. Rijeka, Croatia: Intech Publishing.