The Effects of Explanatory-Based Training on Food Safety Motivation to Learn and Learning Performance

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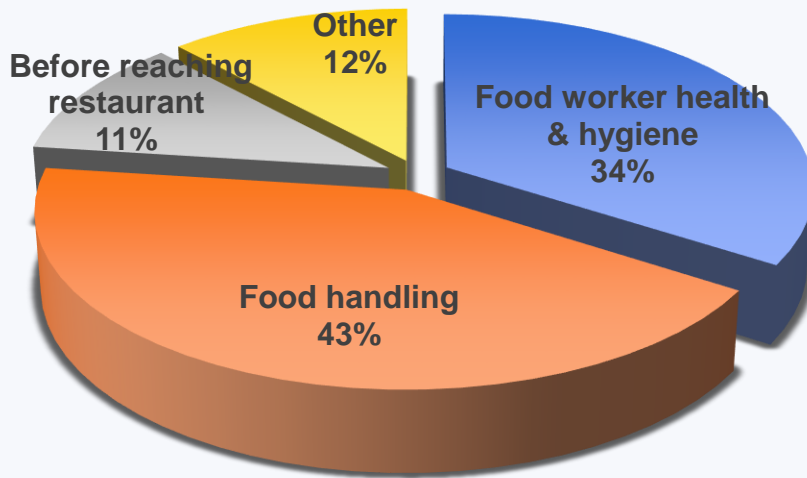[1]Sun Yat-sen University [2]University of Missouri;

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Research Background

Foodborne illness Outbreaks in Restaurant 1998-2013

9788 restaurant-associated outbreaks

Food worker health & hygiene 34%

Food handling 43%

Before reaching restaurant 11%

Other 12%

(Angelo et al., 2017)

ServSafe — **Food safety training**

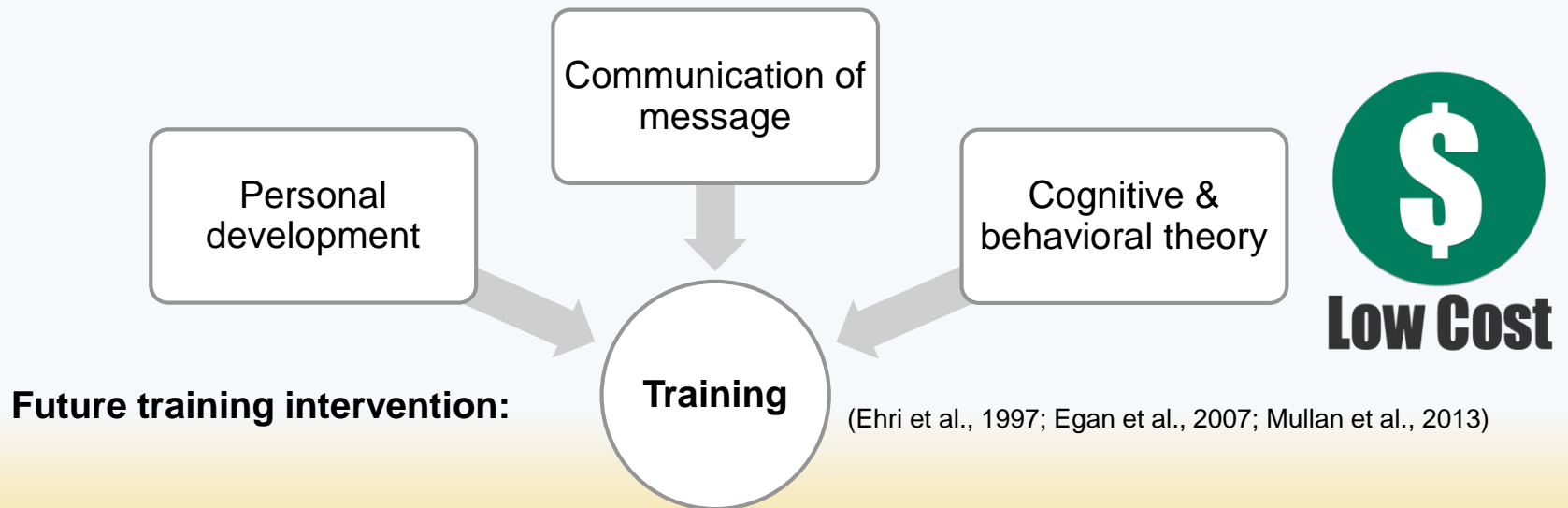(Medeios et al., 2011; Nik, Hussan et al., 2016; Zanin et al., 2017)

Research Background

- Employees' low monitoring to learn
- Short learning retention
- Low transfer effectiveness
- Lack of effective follow-up monitoring

(Soon et al., 2011; Medeiros et al., 2011; Nik, Hussan et al., 2016; Zanin et al., 2017)

Communication of message

Personal development

Cognitive & behavioral theory

$ Low Cost

Future training intervention:

Training

(Ehri et al., 1997; Egan et al., 2007; Mullan et al., 2013)

Problem Statement

Explanatory-based training (EBT): the training method that trainers guide trainees to understand the relevant domain knowledge before introducing topic-specific information (Mitchell et al., 1986)

Stage 1   **Stage 2**

EBT

Food safety training

Microbiology

Epidemiology

Food Safety Knowledge
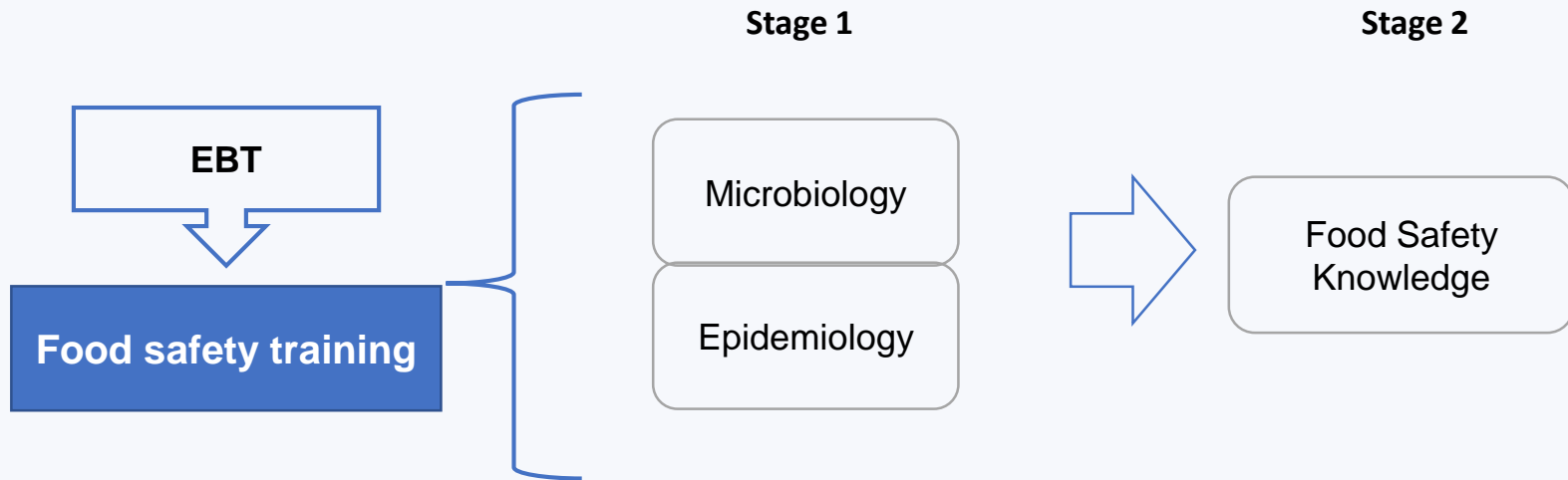
Objectives

Objectives 1

Examine the impact of domain knowledge introduction on trainees' post-training knowledge acquisition and knowledge increase

Objectives 2

Investigate the influence of domain knowledge introduction on post-training motivation and motivation increase

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Literature Review

Applied Psychology

General rule theory: Training will be more effective when trainers not only introduce applicable skills but also explain the general rules and theoretical principles underline the contents (Mcehee & Thayer, 1961)

Interactive cognitive complexity theory: Learning is the outcome of an interaction between learners' affective and cognitive structures

Cognitive Psychology

Construction integration theory: Trainees with higher domain knowledge have better comprehension level of and higher level of motivation to acquire science-related information (Kinsch, 1998)

EBT Scheme

Domain knowledge

Specific skills

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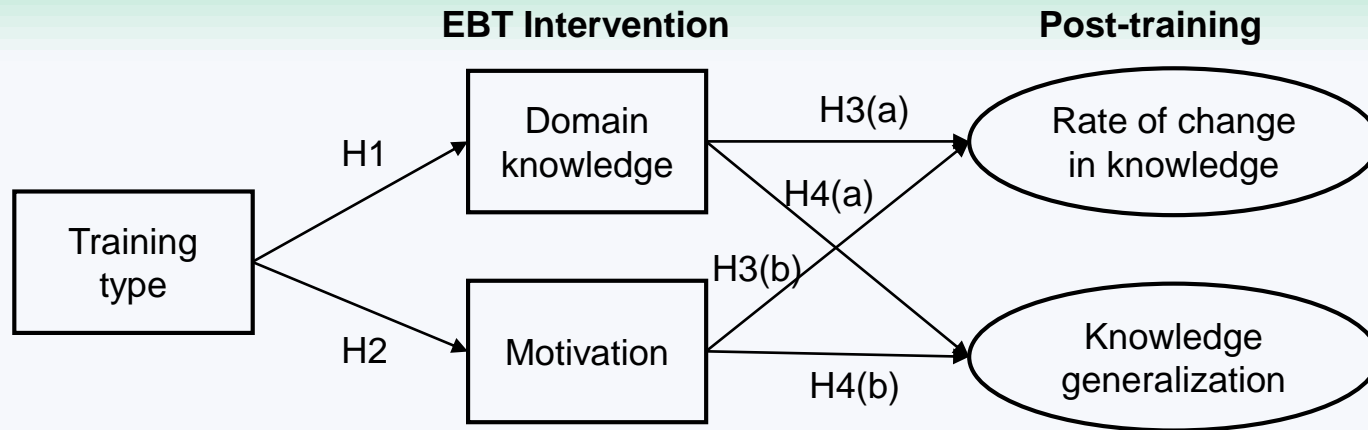## Training: Human Knowledge/Skill/Ability (KSA) Development

Training Effectiveness:
- The post-training level of KSA
- The rate of change in KSA
- The generalization of KSA (i.e., problem-solving skills)
  (Baldwin & Ford, 1988; Blume et al., 2010)

The rate of change and generalization of KSA in KSA are more valid measurements of training effectiveness in the condition of significant differences in pre-training KSA level (Baard et al., 2010; Blume et al., 2010; Huang et al., 2016; Lindsley et al., 1995)

Performance

High

Low

Trainee 1

Trainee 2

Day 1

Day N

Time
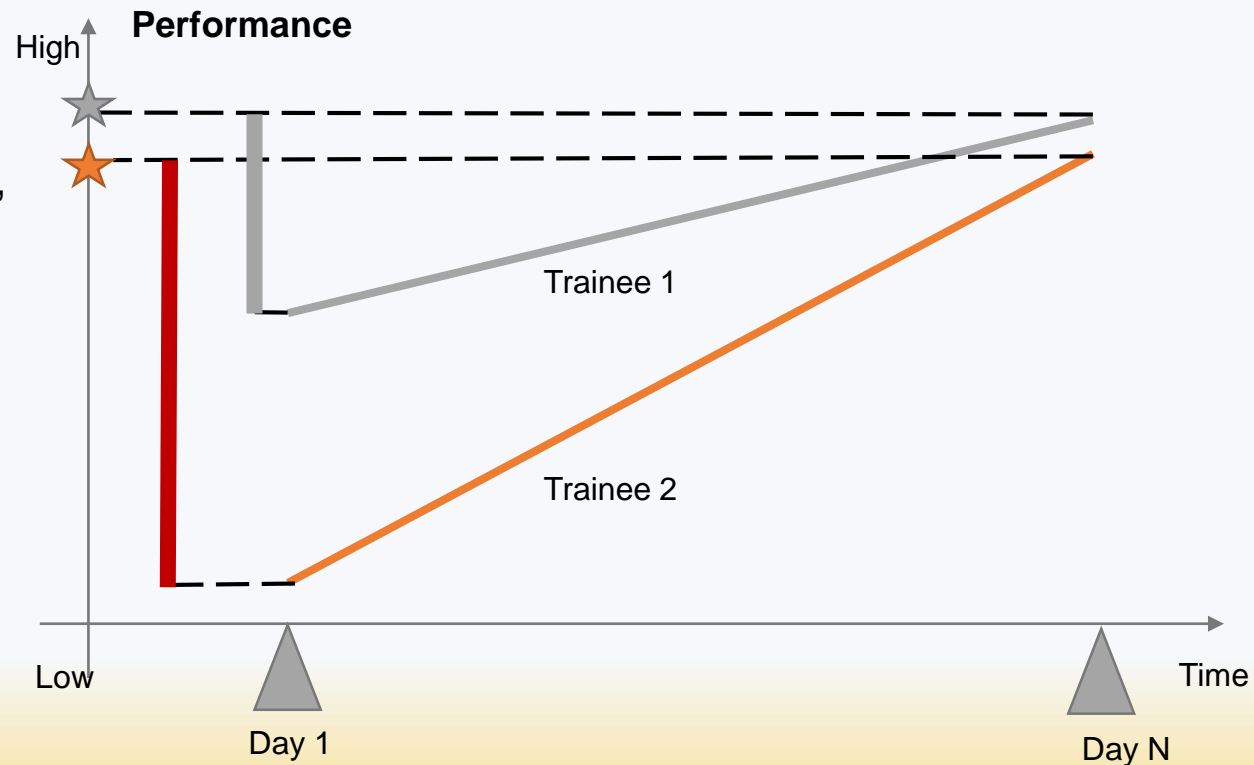
Conceptual Model and Hypotheses Development

EBT Intervention   **Post-training**

H1: The pre-training domain knowledge is higher for trainees receiving EBT than those in the control group.

H2: The pre-training motivation to training is higher for trainees receiving EBT than those in the control group.

H3: The food safety knowledge growth is higher for trainees receiving EBT than those in the control group and the positive path is mediated by (a) domain knowledge and (b) motivation to learn

H4: The problem-solving level is higher for trainees receiving EBT than those in the control group and the positive path is mediated by (a) domain knowledge and (b) motivation to learn
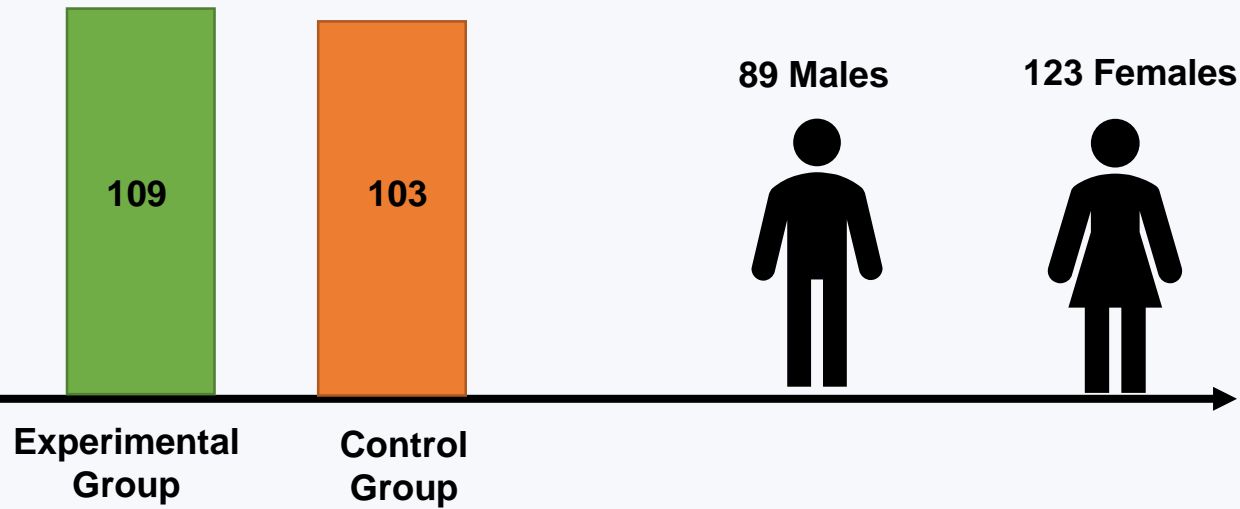
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Methodology

Sample and Data Collection

212 Food handlers

109 — Experimental Group

103 — Control Group

89 Males

123 Females

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Methodology

Research Design

A longitudinal between-subject factorial design

Wave	Experimental	Control	Information
Pre-training (0)	Receiving first survey	Receiving first survey	• Demographic info • Basic topic knowledge
EBT Session (1)	Receiving a three-hour EBT intervention	N/A	• Motivation • Domain knowledge
Training	Receiving a four-week training	Receiving a four-week training	
Mid-training (2)	Two weeks after training starts	Two weeks after training starts	• Motivation • Topic knowledge
Post-training (3)	Two weeks after training completed	Two weeks after training completed	• Motivation • Topic knowledge • Problem-solving skills

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Methodology

Training Material and Tools

- **Training Content :** ServSafe Course Book --- Flow of Food (NRA, 2017)

- **Domain knowledge Intervention**
    - Three hours lecture-based session
    - Including how pathogens react to environmental factors and the reasons why some food pathogens lead to unique symptoms
    - Introduced by short video and animations

Methodology

Measurements

Measure	No. of Items	Cronbach's alpha
Food safety knowledge (FSK): Multiple-choices (ServSafe® Manager, 2017 & Yu et al., 2017)	10	-
Motivation to learn (MOT) (Noe, 1984)	4	0.90
Food safety domain knowledge (DK): Multiple-choices	10	-
Knowledge generalization (KG): Scenario-based food safety problem-solving questions	10	0.81

Data analysis – *Mplus 7.4*

Longitudinal CFA (Little, 2013):

- Investigate measure invariant across three waves
- Weak factorial invariance should be satisfied ($\lambda_{ij1} = \lambda_{ij2} = \lambda_{ij3}$)

Multilevel modeling (MLM) (Peugh & Heck, 2017):
- Robust Maximum Likelihood Estimation (MLR)
- Test 5 hierarchical-nested models

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Results

Descriptive analysis and construct validity

Variable	M	SD	Skewness	Kurtosis	1	2	3	4	5	6	7	8
1. FSK T1	3.55	2.47	0.04	0.02	1							
2. FSK T3	5.71	3.94	0.09	-0.58	0.61**	1						
3. FSK T4	6.97	5.00	-0.25	-0.90	0.47**	0.74**	1					
4. MOT T2	4.85	1.09	0.01	-0.07	0.38**	0.21**	0.25**	1				
5. MOT T3	5.30	1.28	-0.42	0.05	0.29**	0.45**	0.47**	0.57**	1			
6. MOT T4	5.65	1.05	-0.73	0.17	0.46**	0.46**	0.52**	0.40**	0.70**	1		
7. DK	3.86	1.26	-1.02	1.74	0.33**	0.35**	0.40**	0.45**	0.40**	0.32**	1	
8. KG	3.75	1.28	-1.85	4.80	0.26**	0.49**	0.44**	0.31**	0.51**	0.34**	0.38**	1

Note. *$p<.05$; **$p<.01$; T1= Assessment time point 1; T2= Assessment time point 2; T3= Assessment time point 3; T4= Assessment time point 4
Missing data were handled by full information maximum likelihood.

Construct Validity: $\chi2 = 315.66$, $df = 187$, CFI= .98, TLI= .97, RMSEA= .05, SRMR= .04

Convergence & Discriminant Validity: $AVE > 0.5 \ \cap \ \underset{0<\alpha<8}{\mathrm{AVE}} > \max \sqrt{\gamma}$

Results

Hypotheses test --- Preliminary test
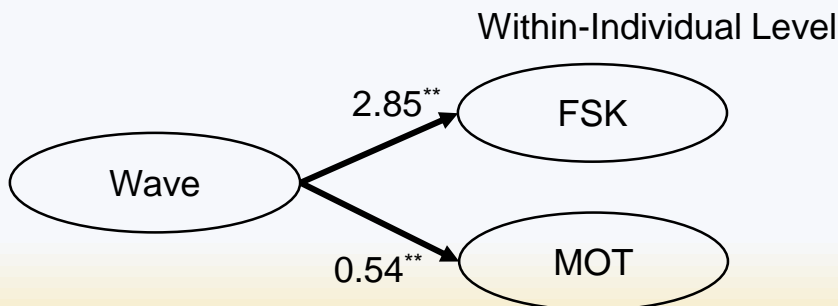
Model 1: Unconditional Model

Intraclass correlation (ICC): Partition the variance to Within-person and Between-person level
- $ICC_{(FSK)} = 0.40$
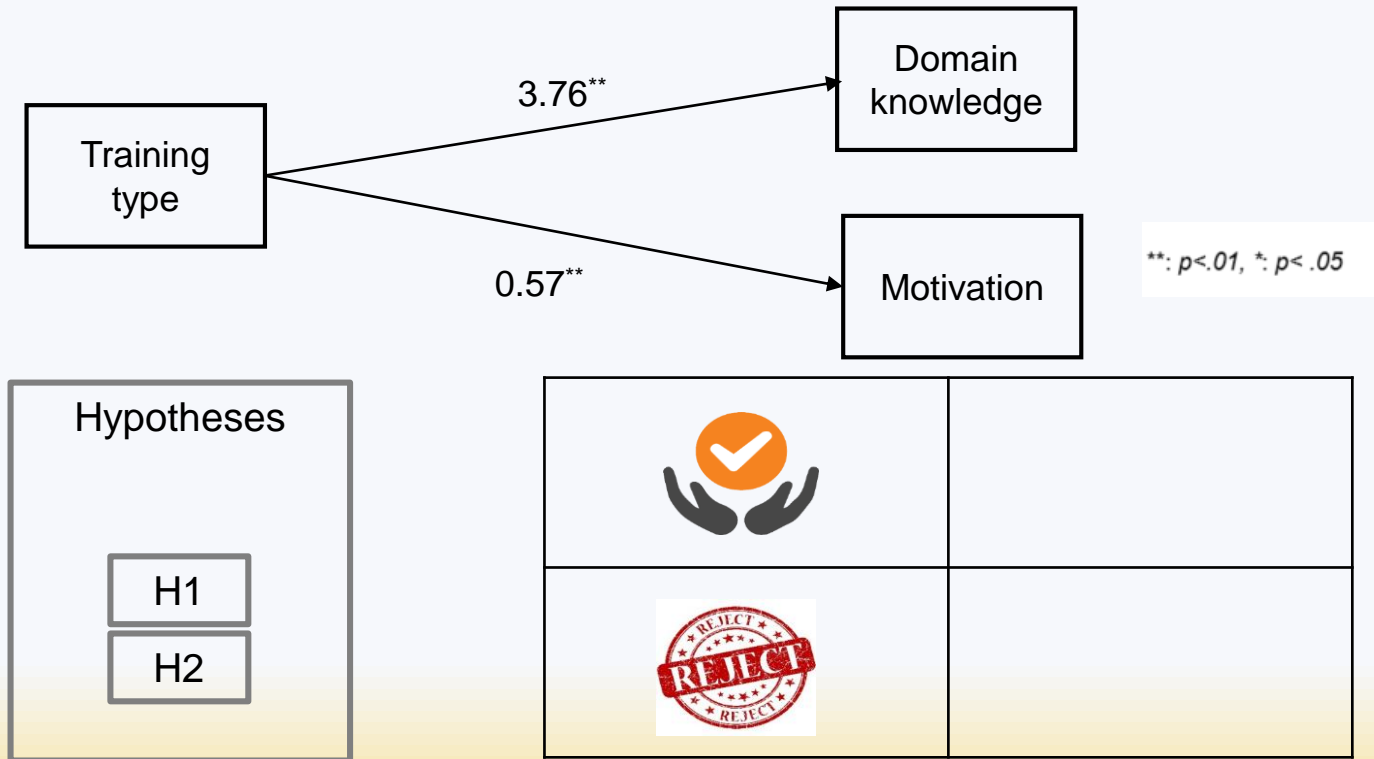- $ICC_{(MOT)} = 0.25$

Model 2: Time-as-Predictor

Within-Individual Level

Wave

2.85** → FSK

0.54** → MOT

The growth rate of FSK (i.e., slope):
FSK increased 2.85 unit per two weeks

Results

Hypotheses test --- Model 3

| Training type | → 3.76** → | Domain knowledge |

0.57** → Motivation

**: p<.01, *: p< .05

Hypotheses		
H1	✓	
H2	REJECT	

Results

Hypotheses test --- Model 5


```
Training
type
      3.76**          Domain
                      knowledge          0.17**          Rate of change
                                                         in knowledge
                                  0.32**
                      Motivation          0.39**
      0.57**                                             Knowledge
                                          0.49**         generalization
```
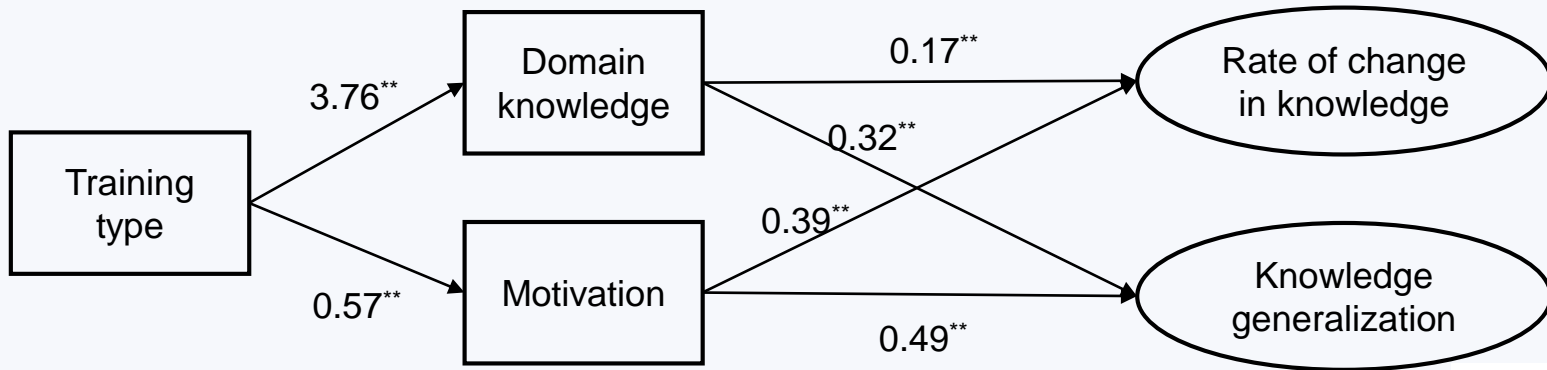
**: $p<.01$, *: $p< .05$

Hypotheses		
H3(a)	✓	
H3(b)		
H4(a)	REJECT	
H4(b)		

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Discussion

Effectiveness and Mechanism of EBT

EBT

Cognitive Process- DK

Affective Process-MOT

FOOD SAFETY TRAINING
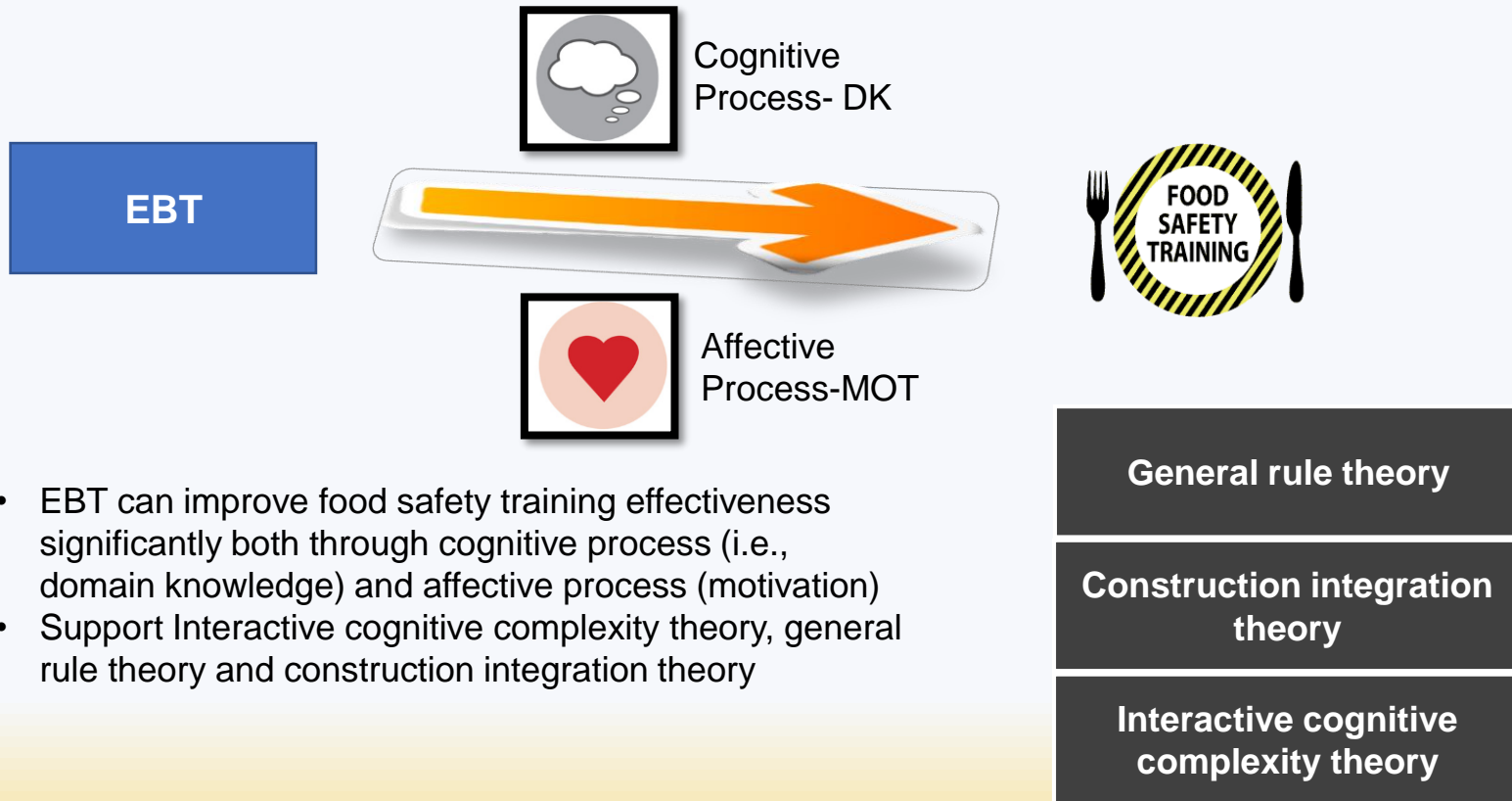
- EBT can improve food safety training effectiveness significantly both through cognitive process (i.e., domain knowledge) and affective process (motivation)
- Support Interactive cognitive complexity theory, general rule theory and construction integration theory

General rule theory

Construction integration theory

Interactive cognitive complexity theory

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Discussion

EBT influences knowledge acquisition and generalization

Rate of change in knowledge

Knowledge generalization
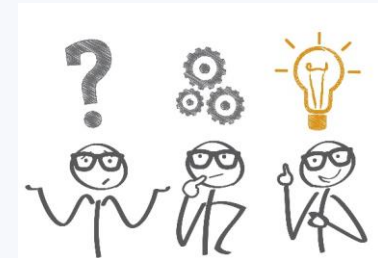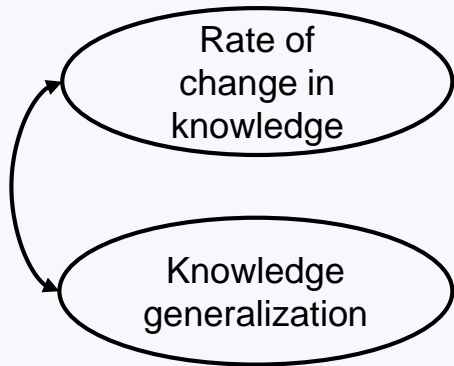
Problem-solving

EBT

Limitation and Future Research

o The current study cannot capture the transfer effectiveness of food safety training such as maintenance and generalization of the training. (Blume et al., 2010)

   Solution: Develop a longitudinal study to track trainees' food safety training transfer effectiveness in mid to long term and identify the key factors influencing food safety transfer effectiveness.

o The delivery method of domain knowledge was limited in the literature.

   Solution: Develop experimental study to examine the effectiveness of training delivery approach other than lecture.

o All the constructs were measured by self-reported data.

   Solution: Future research uses multi-source data to estimate behaviors using cross-level polynomial regression and response surface method.