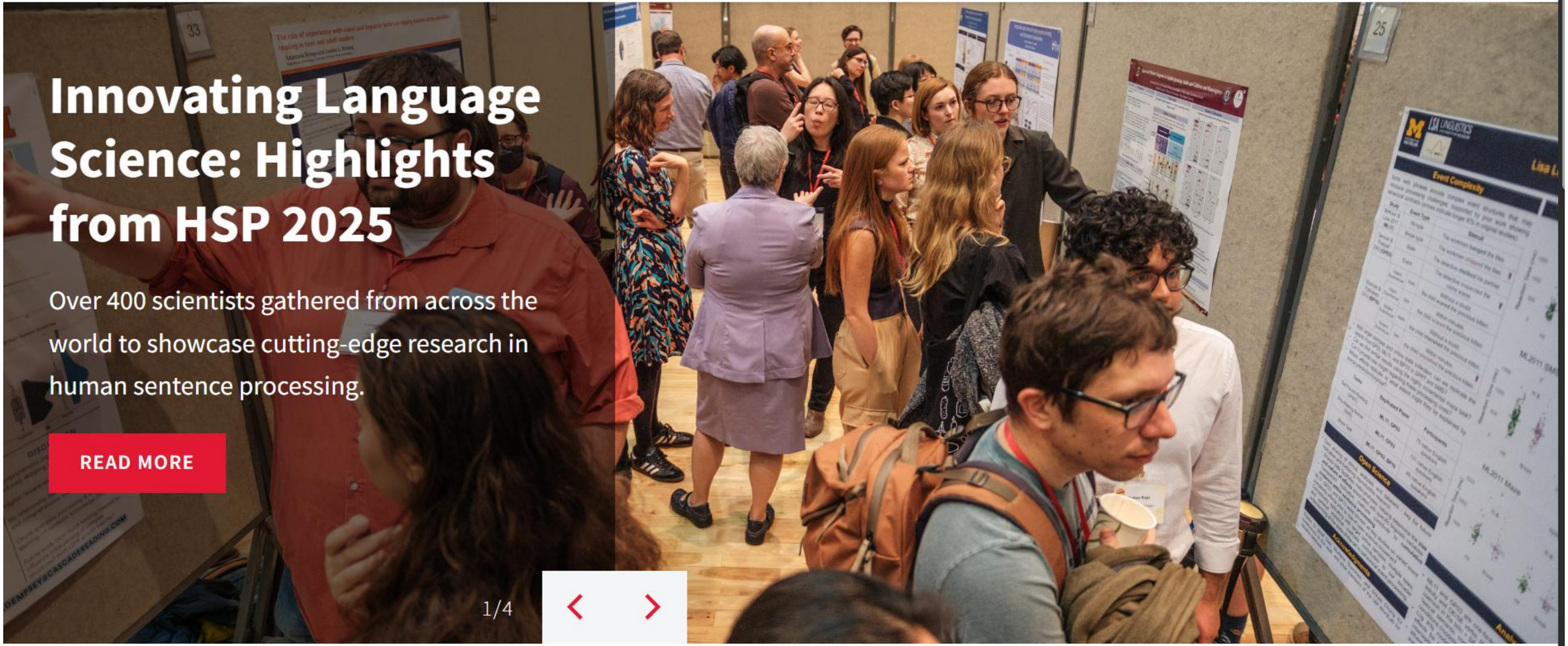
# Effects of vocabulary practice timing on collocation learning and neural synchronization in task-based interaction

Yuichi Suzuki (Waseda University)
Takayuki Nozawa (University of Toyama)
Takumi Uchihara (Tohoku University)
Sachiko Nakamura (Tamagawa University)
Hyeonjeong Jeong (Tohoku University)
Atsuko Miyazaki (The University of Tokyo)

UNIVERSITY OF MARYLAND

MARYLAND LANGUAGE SCIENCE CENTER





# Innovating Language Science: Highlights from HSP 2025

Over 400 scientists gathered from across the world to showcase cutting-edge research in human sentence processing.

READ MORE

1/4

## Explore The Language Science Center

# Language at Maryland

building an integrated science of language

clinical research

neuroscience of hearing and speech

## careers

Students pursue careers in science, education, technology, healthcare, and national security. Maryland graduates in language science are in high demand, due to their broad skills and their track record of innovation.

Recent Maryland graduates are now on the faculties of leading universities in the US and around the world.

## research

Maryland's language research links basic science to applications for learning, technology, and clinical challenges. What gives human brains their unique capacity for language? How can we create better language education programs, computer tools, and therapies? How can insights from individual languages be applied in a global context?

Solutions to these problems require expertise that spans the entire university: language diversity, neural plasticity, advanced computation, research with impaired and gifted populations.

## training

The university has unparalleled facilities for language science, and a host of training programs that equip students to be future leaders in science, technology, healthcare, or education areas related to language. Students develop innovative solutions to language problems by combining expertise from multiple fields, and by drawing on cutting-edge technology, such as the suite of brain scanning technologies at the new Maryland Neuroimaging Center.

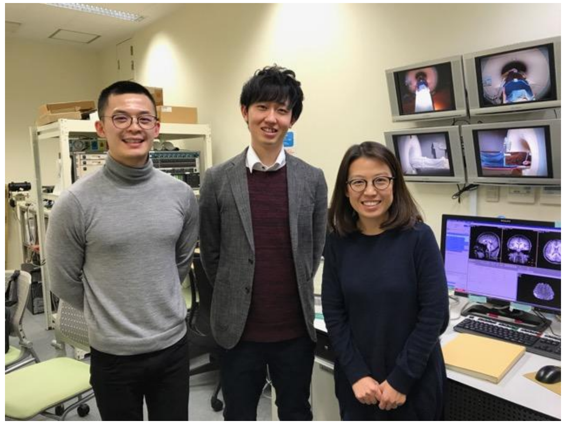
computer models

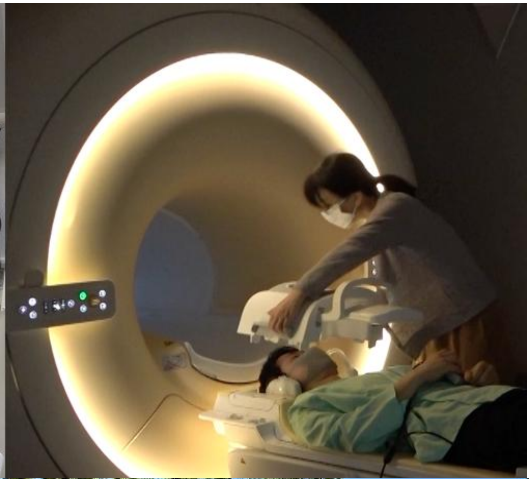
language learning

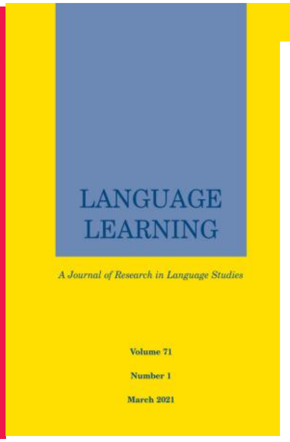
# After going back to Japan…

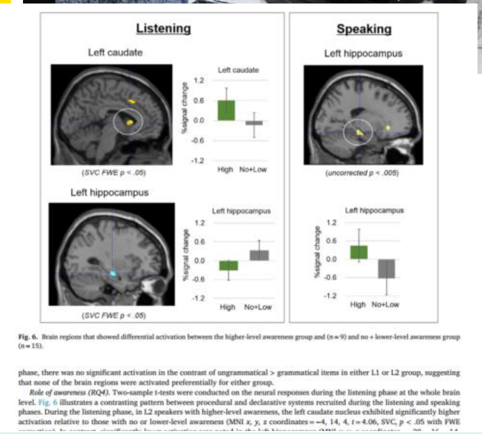
## Research

- Collaboration with L2 researchers and neuroscientists






SLA researcher

## After going back to Japan…

Teaching Position

- Kanagawa University (2015 - 2024)
- Waseda University (2024 - Present)

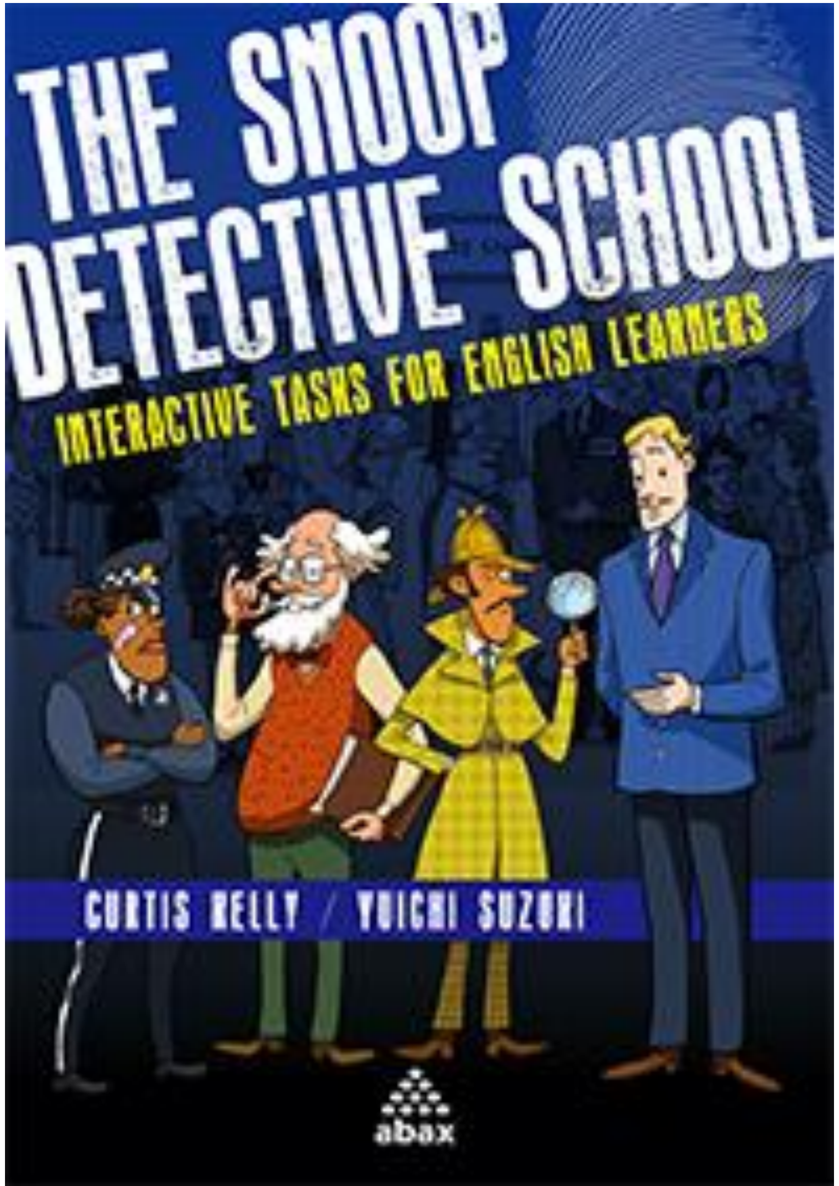
English teacher

# English Teacher and Textbook Writer

Kelly & Suzuki (2025). *The SNOOP detective school*: *Interactive tasks for English learners*. ABAX.

Curtis Kelly
Kansai University

Yuichi Suzuki



# A sample task: “Spy” Task

7

# Industrial Spy A

You can see a video taken by a security camera.

“Dr. Fear has sent an industrial spy to destroy data. Find out what the spy does.”

**Industrial Spy Checklist**

- [ ] Report how the spy entered the building. 1
- [ ] Report how the spy damaged the office. 1
- [ ] The Spy's name is 2

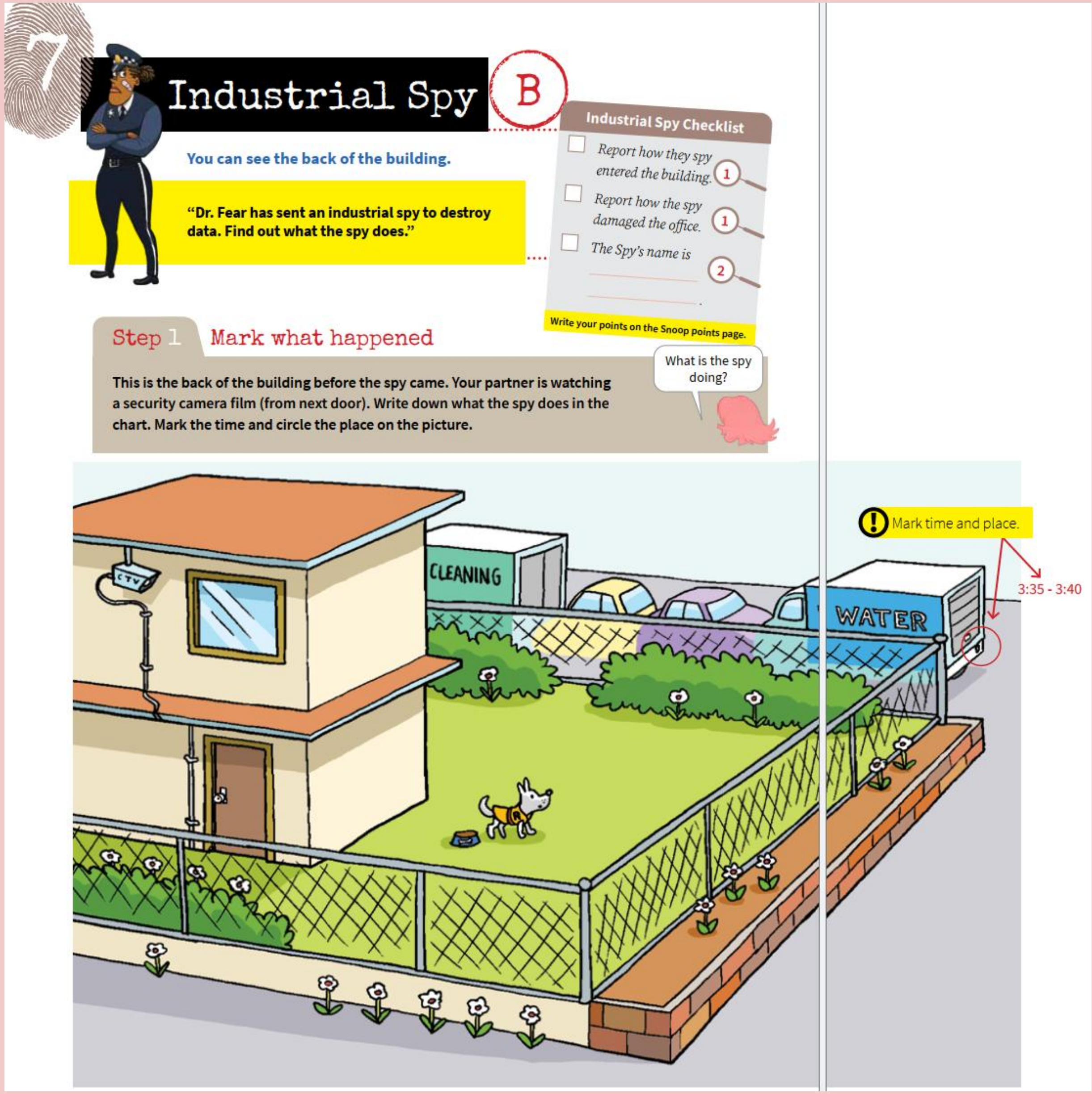
Write your points on the Snoop points page.

## Step 1 Report the office break-in

It's 3:35 am. Do you see a parked truck?

You can see the spy enter the building from a security camera next door. Your partner sees the back of the building. Tell your partner what the spy does.





7

# Industrial Spy B

You can see the back of the building.

“Dr. Fear has sent an industrial spy to destroy data. Find out what the spy does.”

**Industrial Spy Checklist**

- [ ] Report how they spy entered the building. 1
- [ ] Report how the spy damaged the office. 1
- [ ] The Spy's name is 2

Write your points on the Snoop points page.

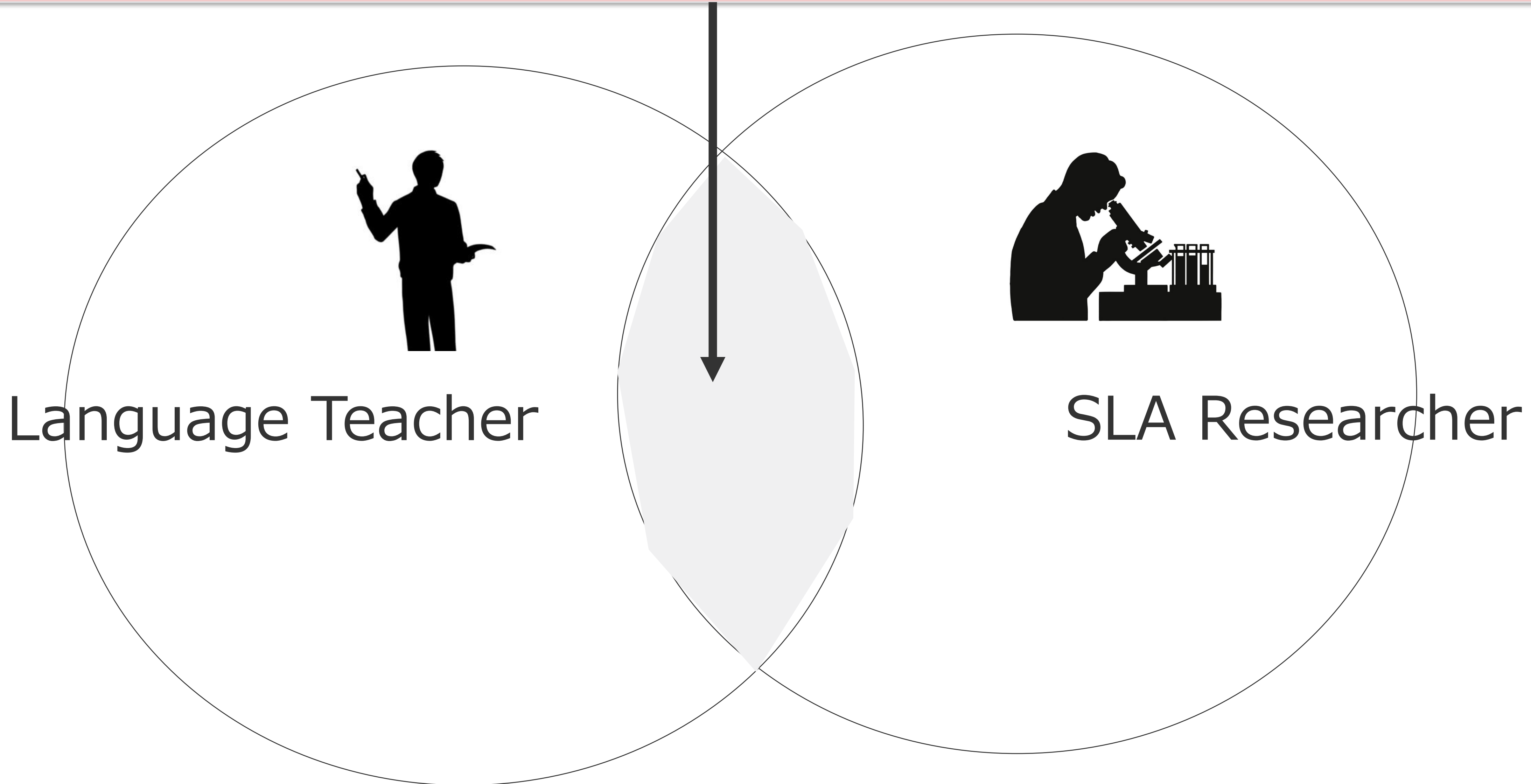
## Step 1 Mark what happened

What is the spy doing?

This is the back of the building before the spy came. Your partner is watching a security camera film (from next door). Write down what the spy does in the chart. Mark the time and circle the place on the picture.

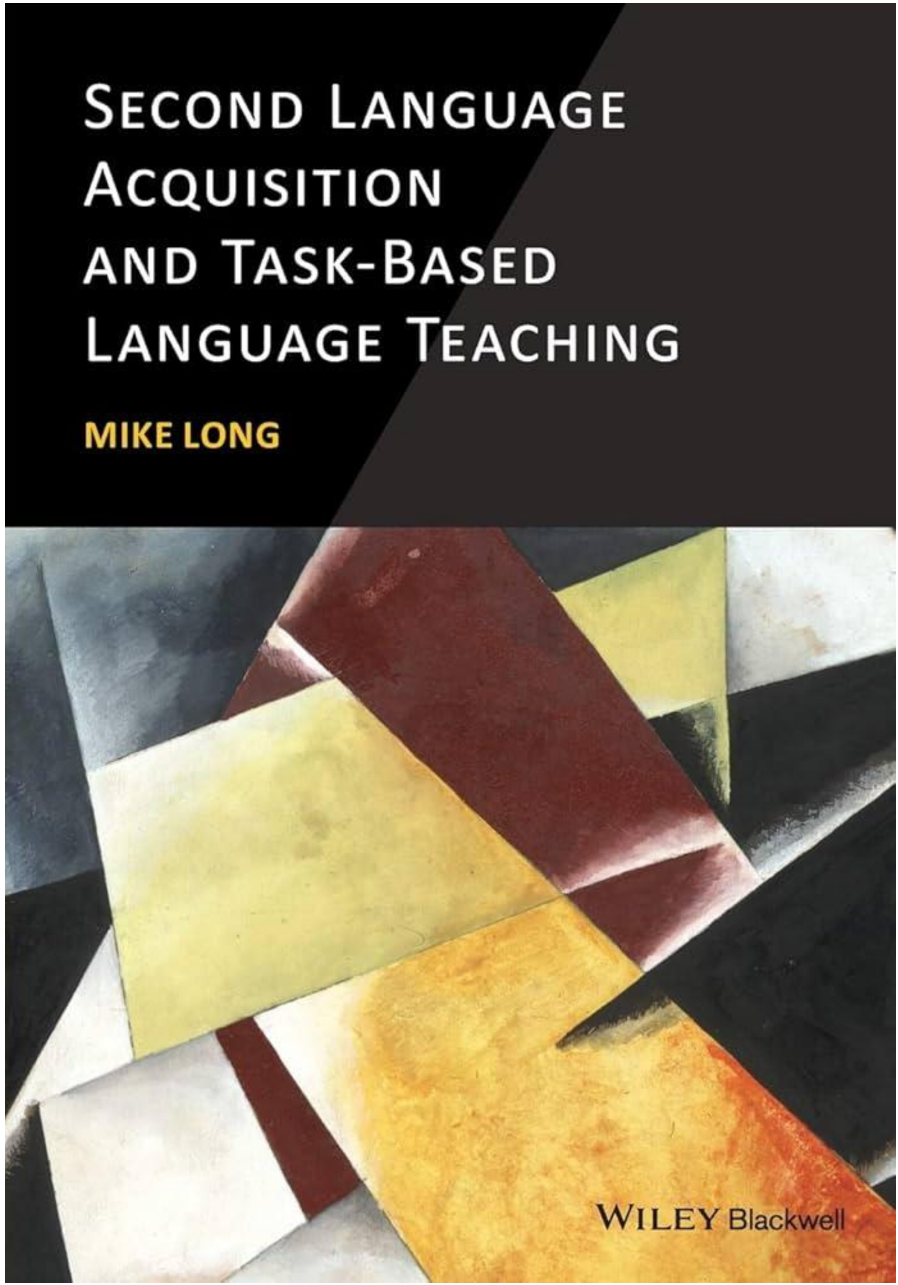
# The Key Question in the Current Project

What is the impact of vocabulary support for interactive tasks?



# Background: Task-Based Language Teaching

- Emphasis on "learning by doing" through meaningful communication (Long, 2015)
- Aligns with usage-based perspectives on language learning (Ellis & Wulff, 2015)
- Formulaic sequences such as collocations are important for fluent speech production (Siyanova-Chanturia & Pellicer-Sánchez, 2018; Wary, 2002).



# How should we integrate lexical instruction with task?

- The effects of pre-task lexical instruction has been studied in contextualized reading and writing tasks (e.g., Altamimi & Conklin, 2024; Elgort et al., 2024; Pellicer-Sánchez et al., 2021; Webb, 2009).
- Eye-tracking research revealed that learners direct their attention to pre-taught lexical items more; and they learn more lexical items that are pre-taught.
- However, limited research on speaking tasks.
  - Vocabulary can be learned through interaction (e.g., Ellis & He, 1999; Newton, 2013).

# We need to understand vocabulary teaching in TBLT

- Shintani et al. (2025) interviewed a Japanese high school teacher who adopted TBLT. They revealed the teacher's concerns related to vocabulary when using info-gap tasks:

> Evaluating her task-based lesson, she repeatedly pointed out that the difficulty of the vocabulary in the task hindered their performance.
>
> – *I realised that the students could communicate with given information if they have a certain vocabulary.*
>
> – *I thought the vocabulary was quite difficult.*
>
> – *I think how much they know the words determined how smoothly they could perform the task.*

# How should we integrate lexical instruction with communication task?

- **Pre-task vocabulary practice:** Prepares learners to use target vocabulary and enhance learning (Schmitt, 2008; Willis & Willis, 2008).BUT, it may interfere with communication (R. Ellis et al., 2020; Skehan, 1998).
- **Post-task vocabulary practice:** Maintains communication focus but may reduce the productive use of target vocabulary during task.

# de la Fuente (2006)

- Compared the effectiveness of pre-task and post-task vocabulary practice for lexical acquisition through information-gap and role-play tasks.
- The post-task group demonstrated significantly better results in the delayed posttest conducted one week later.
- However, the study included several differences between groups beyond lexical instructional timing (e.g., planning, focus on form).

These different variables make it difficult to isolate the effects of vocabulary practice timing alone.

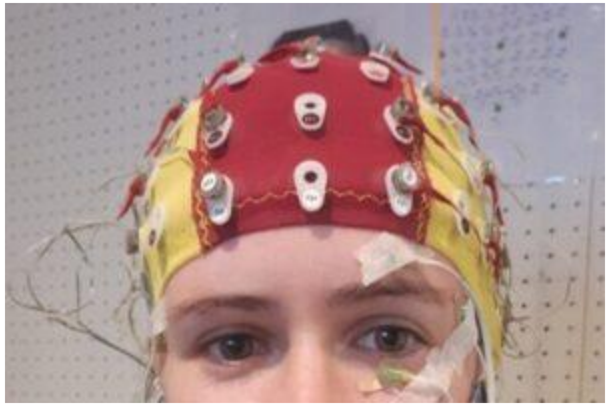
# Two research gaps

1. Outcome Measures
   - Multifaceted nature of vocabulary knowledge for speaking (e.g., Godfroid, 2019; Nation, 202; Uchihara et al., 2024)
   - Declarative knowledge and processing efficiency
2. Task performance
   - L2 is acquired through collaborative problem-solving through interaction in TBLT.
   - Does quality of communication predict lexical acquisition?

# How can we measure the quality of communication?

## Hyperscanning with fNIRS

## EEG



## fMRI

# fNIRS for vocabulary learning

fNIRS allows for measuring **inter-brain synchronization (IBS)** between two individuals during interaction.

- In education research, IBS has been found to be linked to:
  - Social cognition and language processing (Zhang et al., 2024)
  - Learning outcomes in educational contexts (Tan et al., 2023)
- Neural evidence shows that social context matters for vocab. learning:
  - Vocabulary learning through interaction activates a broader brain network **for social and emotional processing** than decontextualized vocabulary learning (Li & Jeong, 2020).

# Current Study

# SLA x Neuro Project

Yuichi Suzuki

(Waseda University)

Takumi Uchihara

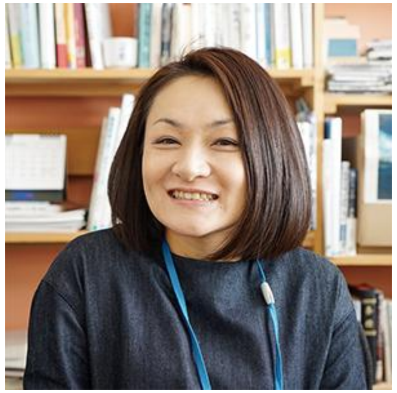
(Tohoku University)

Sachiko Nakamura

(Tamagawa University)

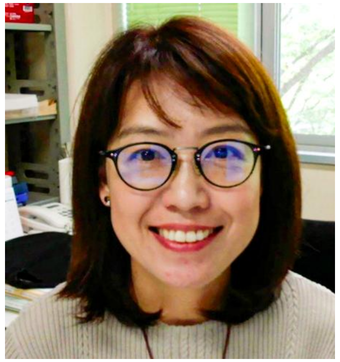
Takayuki Nozawa

(University of Toyama)



Atsuko Miyazaki

(The University of Tokyo)



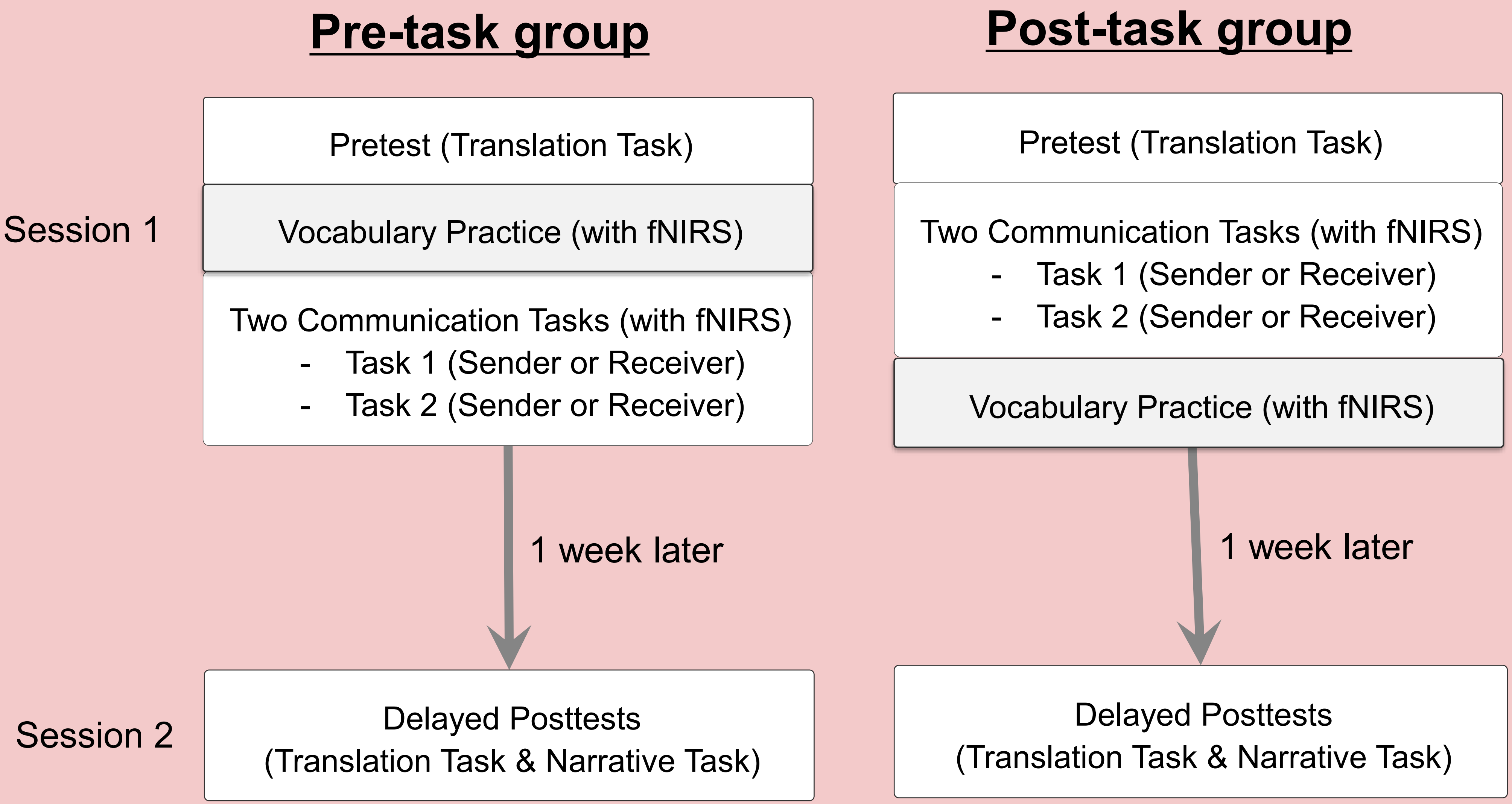
Hyeonjeong Jeong

(Tohoku University)

# Current Study

- Laboratory-based experimental study
- Japanese university EFL learners engaged in interactive speaking tasks
- Timing of deliberate collocation practice was manipulated: pre-task versus post-task

# Overview


Pre-task group
Post-task group
Session 1
Pretest (Translation Task)
Vocabulary Practice (with fNIRS)
Two Communication Tasks (with fNIRS)
- Task 1 (Sender or Receiver)
- Task 2 (Sender or Receiver)
1 week later
Session 2
Delayed Posttests
(Translation Task & Narrative Task)
Pretest (Translation Task)
Two Communication Tasks (with fNIRS)
- Task 1 (Sender or Receiver)
- Task 2 (Sender or Receiver)
Vocabulary Practice (with fNIRS)
1 week later
Delayed Posttests
(Translation Task & Narrative Task)

# Research Questions

**RQ1. To what extent does the timing of vocabulary practice influence lexical learning?**

H1. Pre-task group > Post-task group (Schmitt, 2008).

**RQ2. To what extent does pre-task vocab prac. influence IBS?**

H2. Pre-task group < Post-task group (e.g., Ellis et al., 2020; Skehan, 1998).

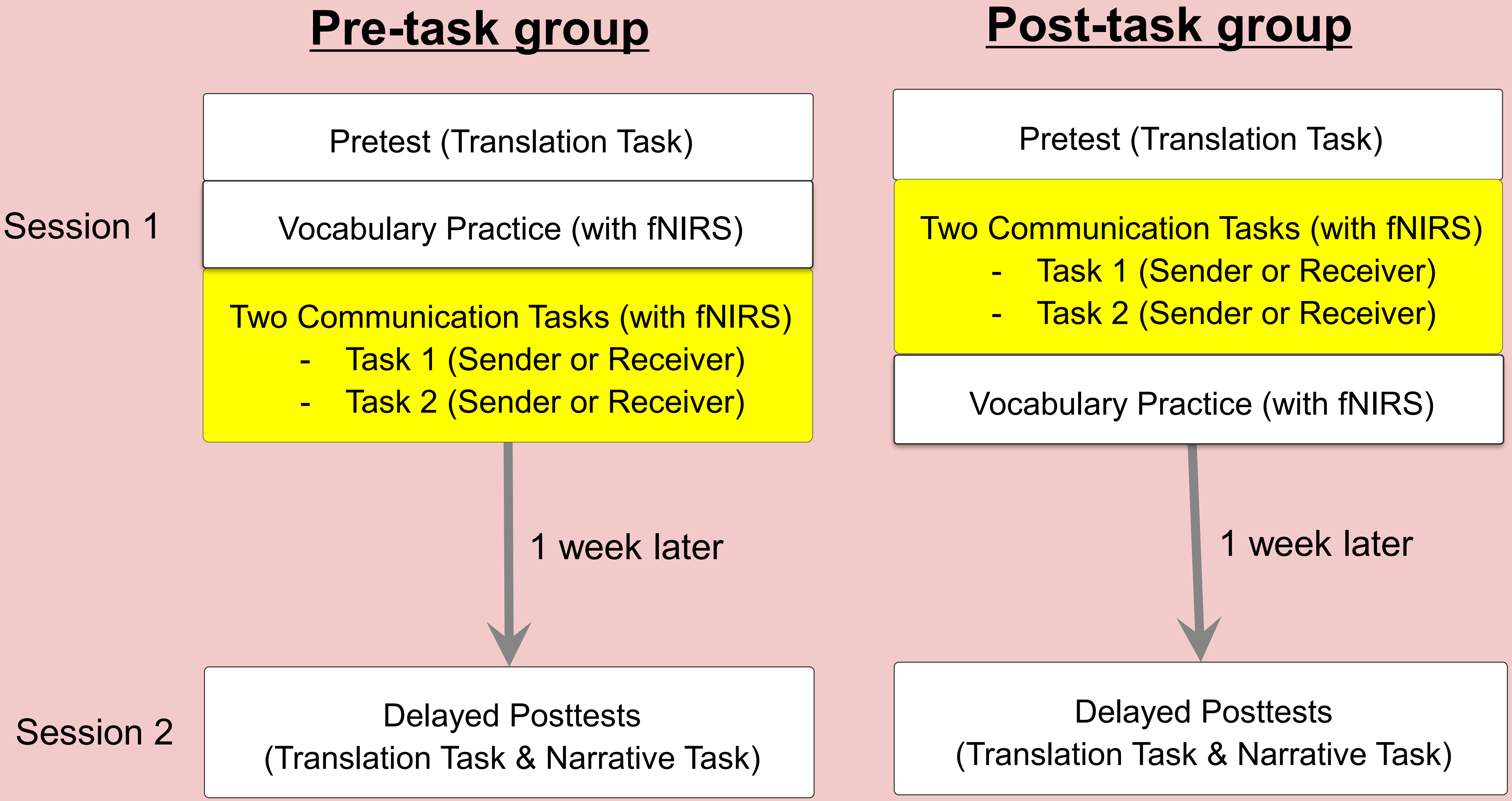
**RQ3. To what extent does IBS predict lexical learning?**

H3. IBS would predict lexical learning.

# Participants

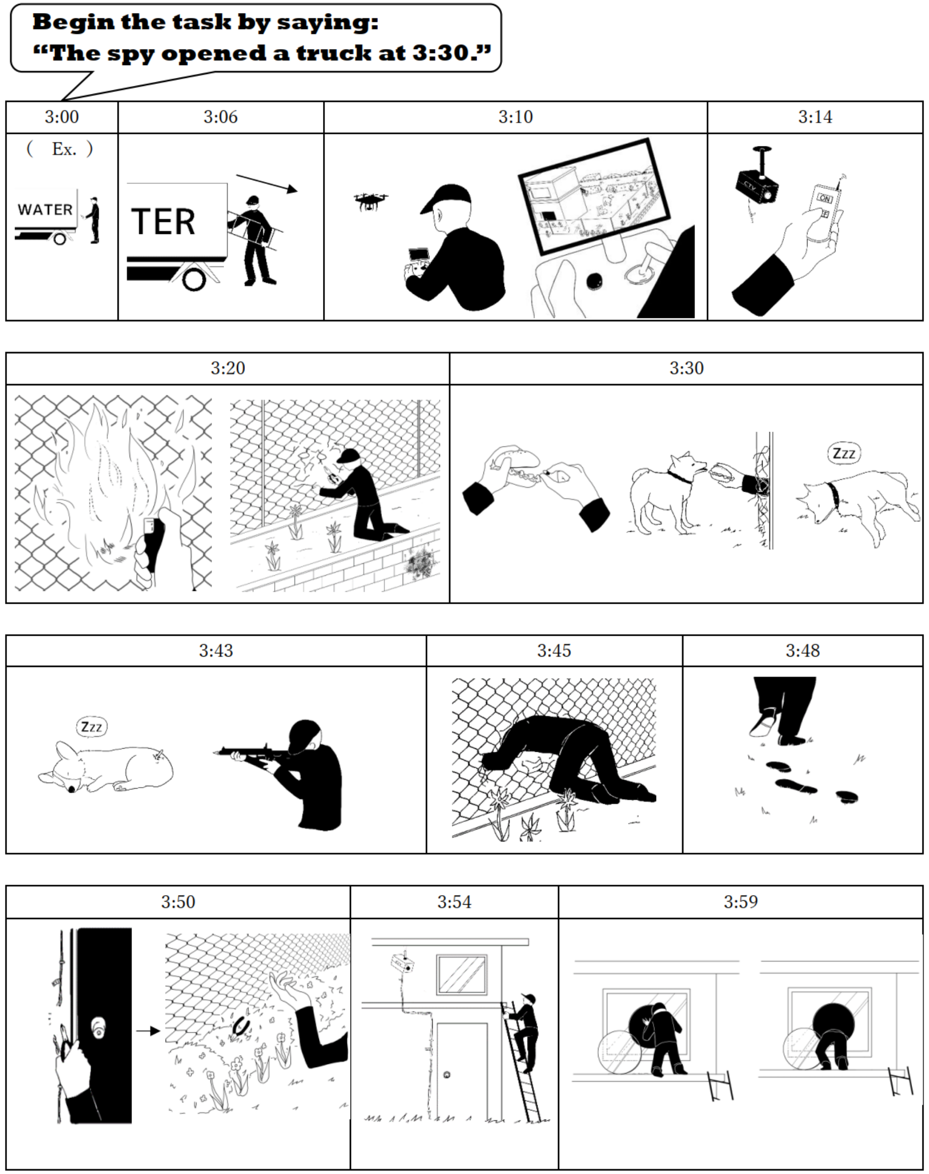
- 80 Japanese learners of English (40 pairs)
- University students (age 18-22) with limited exposure to English-speaking environments, with no individual having spent more than three months studying or residing in an Anglophone country.

# Overview

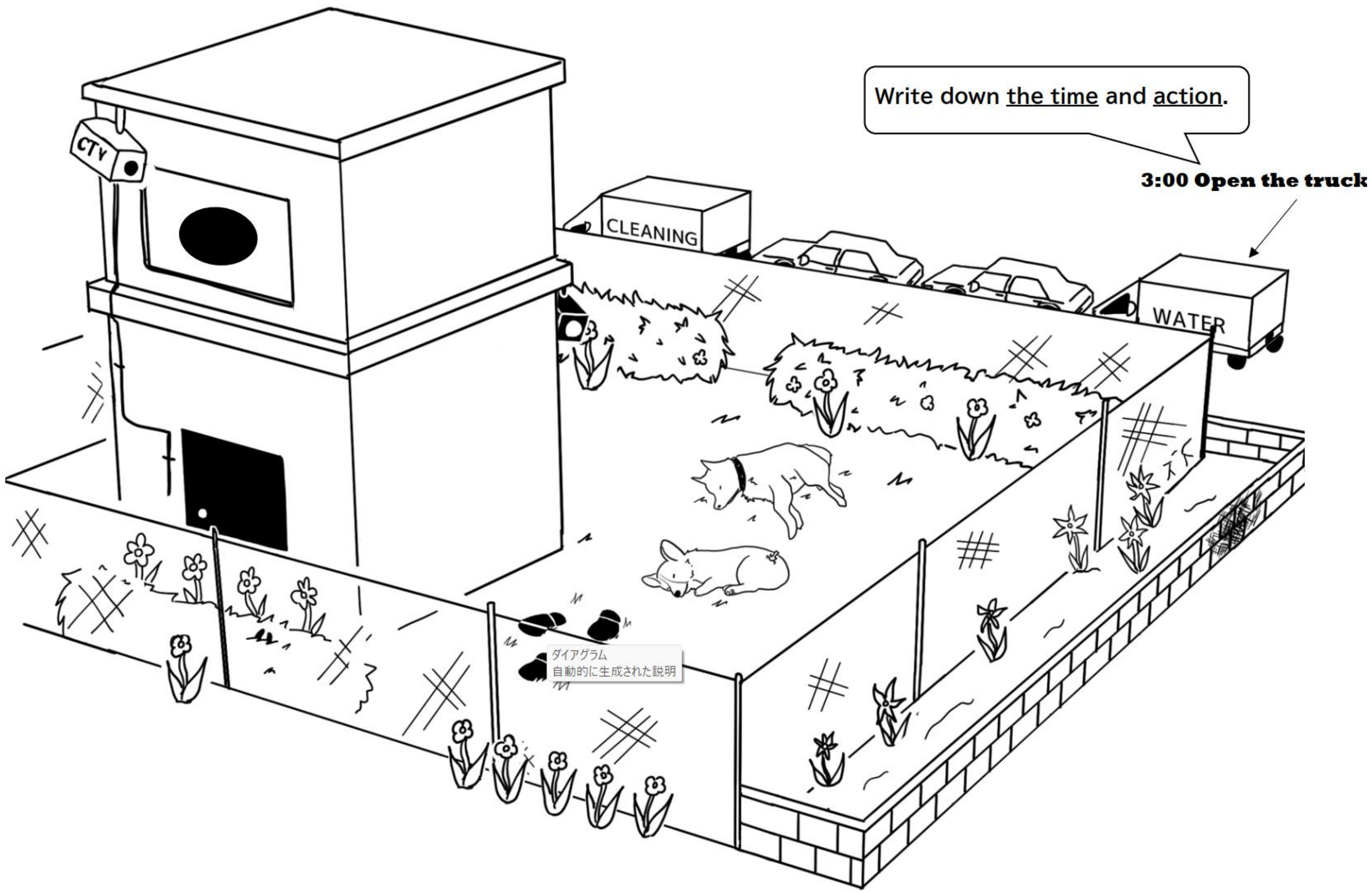

Pre-task group
Post-task group
Session 1
Pretest (Translation Task)
Vocabulary Practice (with fNIRS)
Two Communication Tasks (with fNIRS)
- Task 1 (Sender or Receiver)
- Task 2 (Sender or Receiver)
1 week later
Session 2
Delayed Posttests
(Translation Task & Narrative Task)
Pretest (Translation Task)
Two Communication Tasks (with fNIRS)
- Task 1 (Sender or Receiver)
- Task 2 (Sender or Receiver)
Vocabulary Practice (with fNIRS)
1 week later
Delayed Posttests
(Translation Task & Narrative Task)

# "Company Spy" Task (adapted from Kelly & Suzuki, 2025)

## Sheet A (Sender)

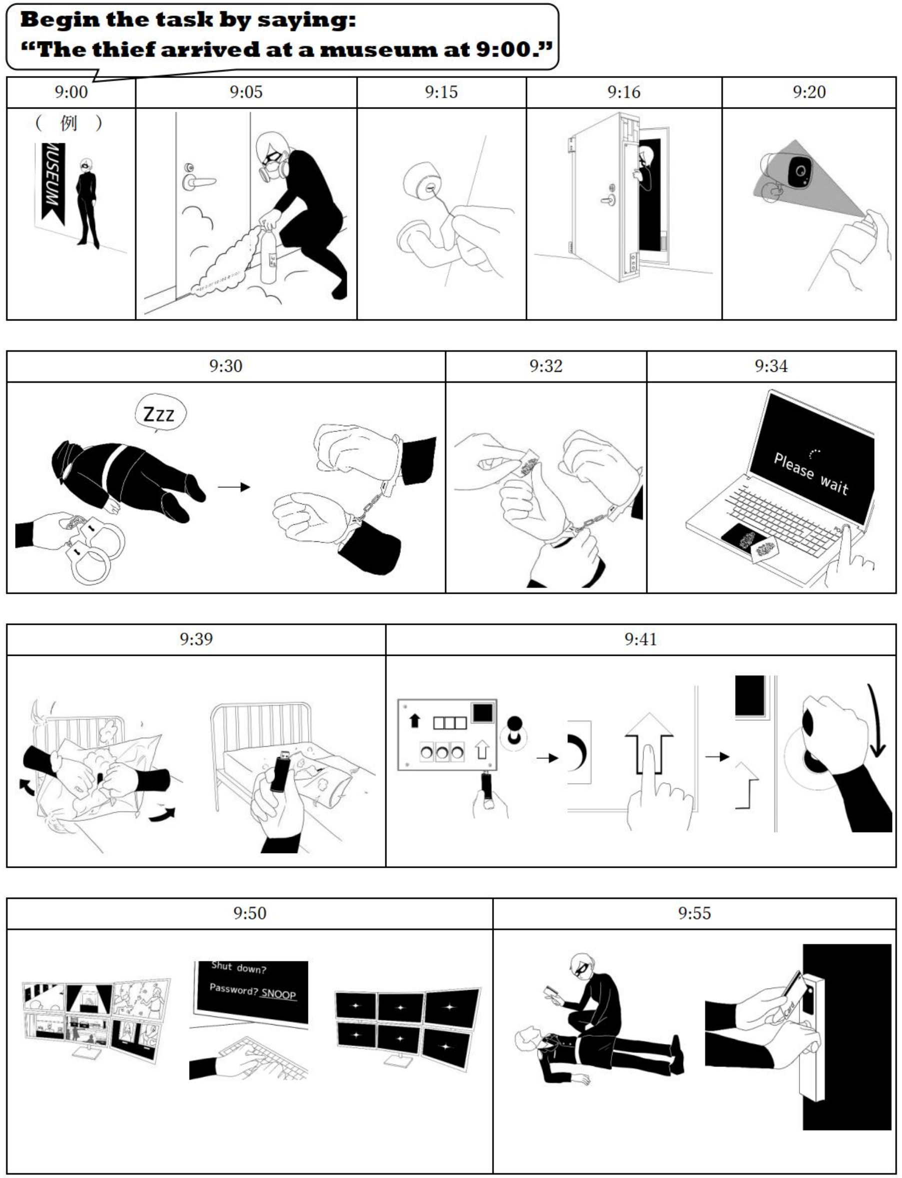



## Sheet B (Receiver)



# “Museum Thief” Task (adapted from Kelly & Suzuki, 2025)

## Sheet A (Sender)




## Sheet B (Receiver)

# Overview

## Pre-task group

Session 1

Pretest (Translation Task)

Vocabulary Practice (with fNIRS)

Two Communication Tasks (with fNIRS)
- Task 1 (Sender or Receiver)
- Task 2 (Sender or Receiver)

1 week later

Session 2

Delayed Posttests
(Translation Task & Narrative Task)

## Post-task group

Session 1

Pretest (Translation Task)

Two Communication Tasks (with fNIRS)
- Task 1 (Sender or Receiver)
- Task 2 (Sender or Receiver)

Vocabulary Practice (with fNIRS)

1 week later

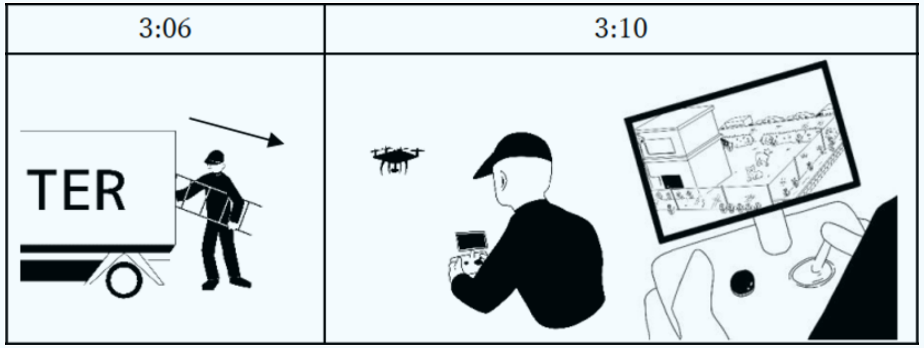
Session 2

Delayed Posttests
(Translation Task & Narrative Task)

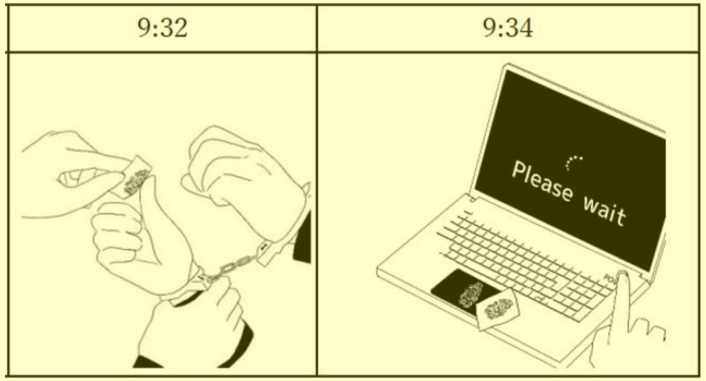
# Target Multiword Expressions

- **22 verb-noun combinations** that are useful for task completion (11 per task)
- All verbs and most nouns are high-frequency words (2000-word level)

**Company Spy Task:**
fly a drone
take out a ladder
Leave footprints


**Museum Thief Task:**
unlock a door
collect fingerprints
turn on a computer

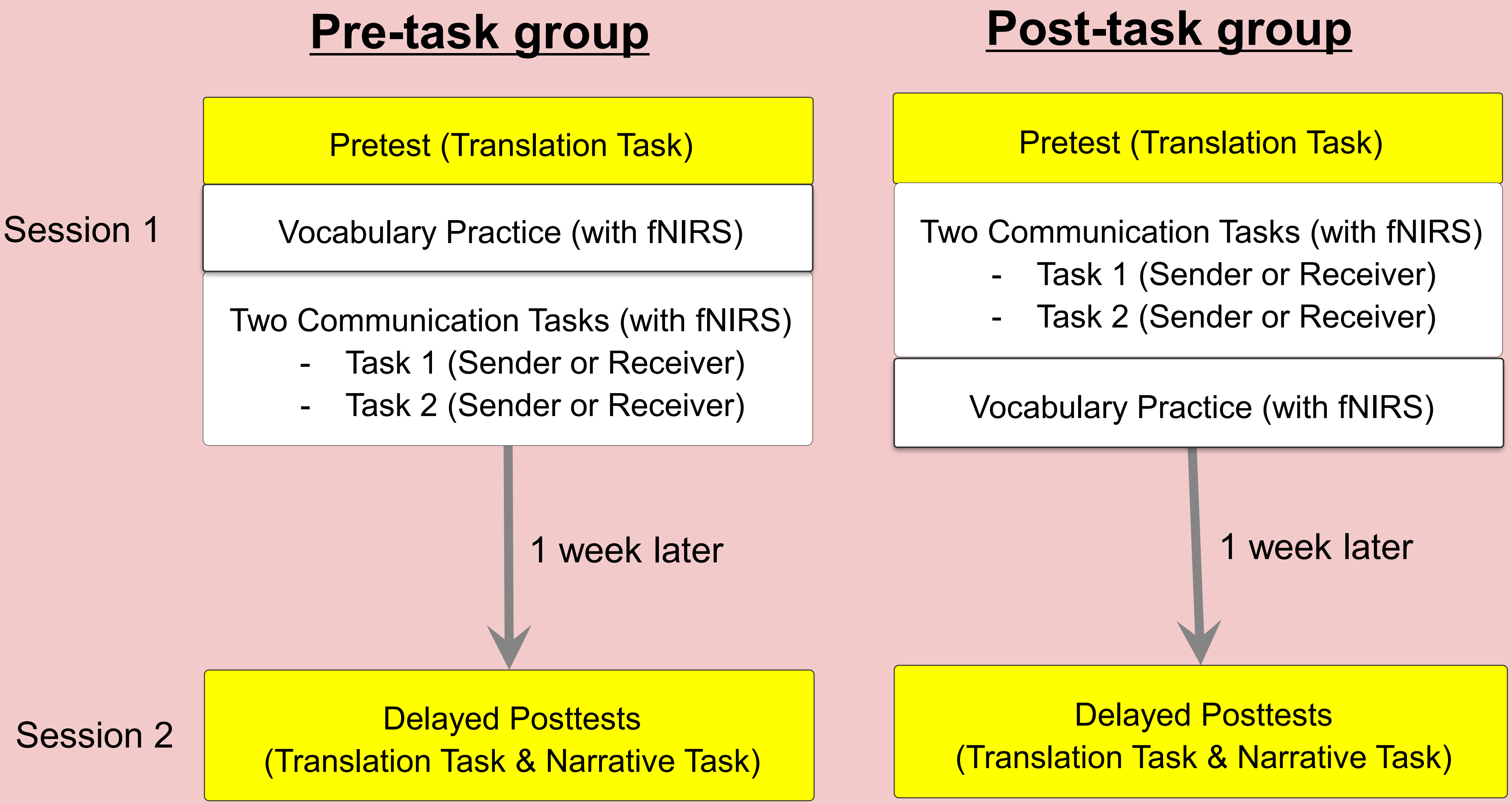
# Vocabulary Practice

1. Listen to audio file to check pronunciation and meaning
2. Paired practice:
   - ➢ Student A (teacher): Gives Japanese translations
   - ➢ Student B (learner): Says English collocations *Can provide feedback
3. Repeat 2 with the switched teacher/learner roles.

## 英語表現リスト

| 和訳 | 英語 |
|---|---|
| ワイヤーを切る | cut a wire |
| パスワードを入力する | enter a password |
| カードキーをかざす | place a card key |
| ドアの鍵を開ける | unlock a door |
| 薬を入れる | put a drug |
| はしごを取り出す | take out a ladder |
| 手錠をかける | put handcuffs |
| フェンスを燃やす | burn a fence |
| ガスを放出する | release gas |
| 指紋を採取する | collect a fingerprint |
| 銃を撃つ | shoot a gun |
| 枕を引き裂く | tear up a pillow |
| ペンチを捨てる | throw away pliers |
| レバーを下げる | pull down a lever |
| 穴を開ける | make a hole |
| 監視カメラの電源を切る | switch off a security camera |
| カメラに塗料を吹き付ける | spray a camera |
| ボタンを押す | press a button |
| 足跡を残す | leave footprints |
| 窓から侵入する | enter through a window |
| コンピューターを起動する | turn on a computer |
| ドローンを飛ばす | fly a drone |

# Overview


Pre-task group
Post-task group
Session 1
Pretest (Translation Task)
Vocabulary Practice (with fNIRS)
Two Communication Tasks (with fNIRS)
- Task 1 (Sender or Receiver)
- Task 2 (Sender or Receiver)
1 week later
Session 2
Delayed Posttests
(Translation Task & Narrative Task)
Pretest (Translation Task)
Two Communication Tasks (with fNIRS)
- Task 1 (Sender or Receiver)
- Task 2 (Sender or Receiver)
Vocabulary Practice (with fNIRS)
1 week later
Delayed Posttests
(Translation Task & Narrative Task)

# Translation Task (Pretest & Posttest)

The item is presented
and the response is audio-recorded.

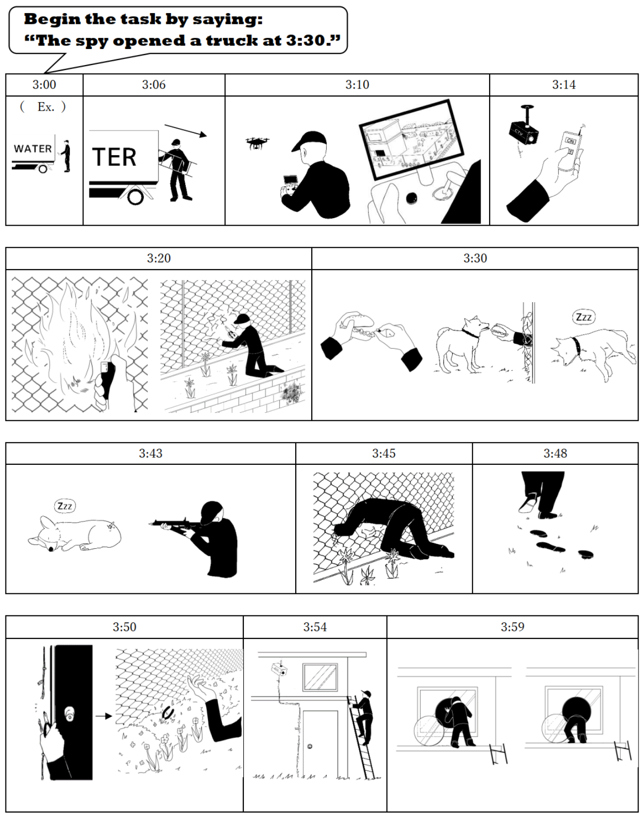
ドローンを飛ばす
( f_ _ ) ( a ) ( d _ _ _ _ _ )

| | |
|---|---|
| Accuracy (Correct recall) | Declarative knowledge of form−meaning mapping in translation |
| Speech rate | Processing efficiency for retrieving form−meaning connection in translation |

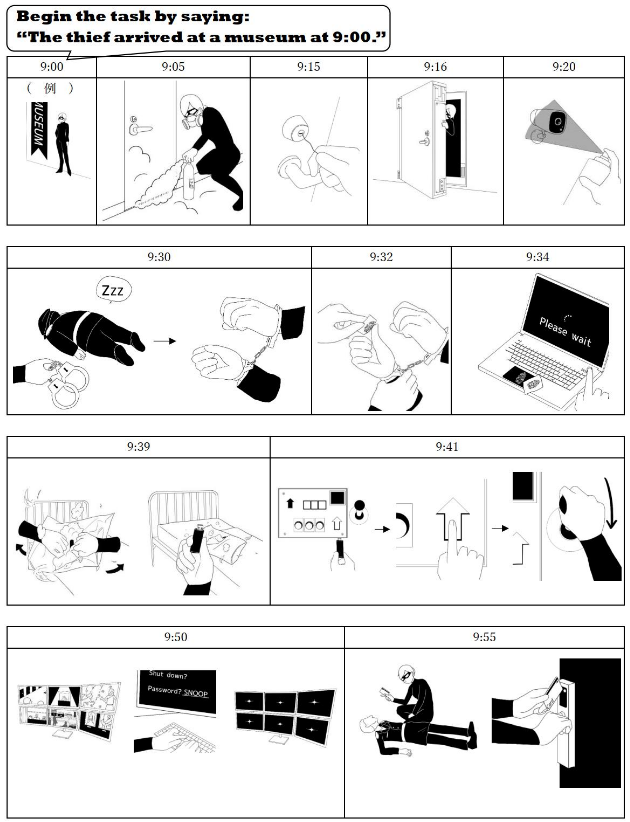
# Narrative Task (Posttest Only)

- A monologue speech
- Eliciting target multiword expressions in context
- No time limit

Sheet A (Sender)




Sheet A (Sender)




| | |
|---|---|
| Accuracy (Correct use in context) | Declarative knowledge of lexical use in context |
| Speech rate | Processing efficiency for lexical use in context |

# Results

# Findings: RQ1 (Timing Effects on Lexical Learning)

**Pre-task group showed significantly better performance :**

- 41% higher odds of accuracy in translation task
- 53% higher odds of accuracy in narrative task

* No significant timing effect on speech rate

# Findings: RQ2 (IBS During Tasks)

**Post-task group showed higher neural synchronization:**

- Stronger IBS in left lateral prefrontal cortex (language processing) in the post-task group
- Suggests more natural communication without pre-task vocabulary practice.
- Pre-task practice may have interfered with natural communication processes by detracting learners’ attention from content/message

# Findings: RQ3 (IBS and Learning)

**Neural synchronization predicted lexical learning**

- Translation task **accuracy** was linked to IBS during
  - Vocabulary practice (right medial PFC)
  - Communication tasks (left lateral PFC)
- Narrative task **speech rate** was linked to IBS during:
  - Vocabulary practice (right medial PFC)

# Discussion

# RQ1: Timing Effects on Lexical Learning

**Pre-task practice led to greater lexical learning in terms of accuracy, not speech rate.**

- ➢ Pre-task facilitated acquisition of declarative knowledge at least.
- ➢ Enhancing automatic processing may need more practice opportunities.
- • Supports importance of establishing initial form-meaning mapping prior to meaningful use (Schmitt, 2008).

# RQ2: IBS During Tasks

**Pre-task practice decreases IBS during communication**

- Provision of collocations may expend the cognitive resources and interfere with natural communication
- In line with some potential drawback of pre-task explicit grammar teaching on task performance (R. Ellis et al., 2019).
- Even pre-task vocabulary practice <u>that are presumably useful for task completion</u> may have some interference effect.

# RQ3: Relationship between IBS and Learning

## Higher IBS predicts better lexical learning

- Neural synchronization in brain regions associated with social cognition (medial PFC) and language processing (left lateral PFC) may facilitate more effective lexical learning.
- Extended previous neuro-education research findings (IBS-learning outcome linkage) to lexical learning.
- Socio-cognitive processes are important for lexical learning in TBLT.

# Implications

**Methodological/Theoretical Contributions**

- fNIRS allows for measuring cognitive and social dimensions during interactive task performance
- Complex interplay between form-focused instruction timing and neural processes and collocation learning

**Practical issues**

- Pre-task practice may change the nature of communication task
- Sequencing tasks should be done judiciously in light of the task goal.

# Limitations & Future Directions

**Current Study Limitations**

- Actual usage of multiword expressions were not analyzed (in progress)
- Cross-sectional design -> Longitudinal?
- Laboratory setting - > Classroom research?

**Future Research?**

- Apply fNIRS in authentic classroom settings

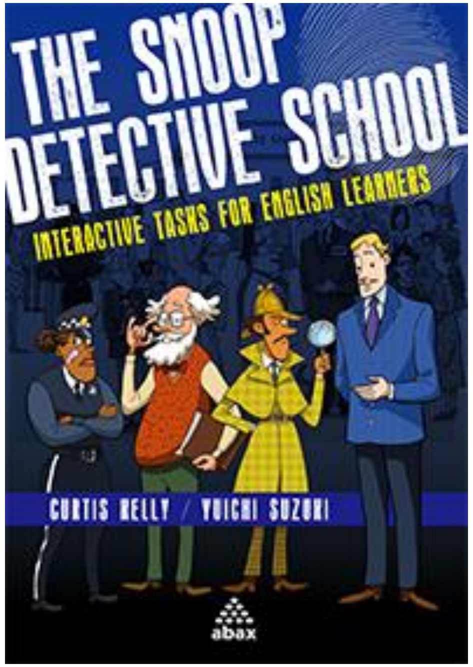
# Classroom research (in progress)

Yuichi Suzuki

(Waseda University)

Sachiko Nakamura

(Tamagawa University)



# fNIRS in classroom?

# Retrospective Questionnaire in classroom?


**Learners' affective states**

**(e.g., emotion and perception)**

# Classroom Research Design

| Pre-Task Vocab-Support Group ($n$ = 30) | Task-Only Group ($n$ = 38) |
|---|---|
| Pretest | |
| Planning with vocabulary list | Planning without vocabulary list |
| Information-gap task (Company Spy) | |
| Information-gap task (Museum Thief) | |
| Posttest | |
| Questionanire on affective states | |

## Research Questions

1. To what extent does pre-task vocabulary support influence lexical learning?

   **Findings: Vocabulary Support > Task-Only**

2. To what extent does per-task vocabulary support influence <u>affective states</u>?
   - Emotions (enjoyment, pride, boredom)
   - Perceived partner’s collaborativeness

# Questionanire on affective states

**Emotions** [4 emotions x 4 items]
“I enjoyed the task.” (**enjoyment**)
“I felt proud of myself while performing the task.” (**pride**)
“I felt bored while performing the task.” (**boredom**)
(Adapted from Nakamura & Leis, 2024)

**Perceived partner collaborativeness** [4 items]
“My task partner was cooperative.”

**6-point Likert scale**
1 (not at all true of me) (strongly disagree)
6 (very true of me) (strongly agree)

# Findings

2. To what extent does per-task vocabulary support influence affective states?

**Compared with Task-Only group, Pre-Task Vocabulary Support group showed lower positive psychological states:**

- Lower enjoyment (and higher boredom)
- Lower pride
- Lower perceived partner's collaborativeness

# Conclusion: Timing Matters

**Pre-task practice enhances lexical learning but may interfere with neural synchronization (and diminish positive emotions).**

**Need for balanced approach in TBLT**

- Consider cognitive, social and affective dimensions.
- Weighing benefits and costs of lexical instruction for interactive tasks.

Any questions?
yszk@waseda.jp