

# Detection of Developmental Abnormalities in Toddlers with Autism Spectrum Disorder



自閉類群障礙幼兒的發展異常偵測

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美國University of California San Diego 自閉症早期療育計畫結訓

## ◆ 研究領域：兒童物理治療、早期療育、自閉症類群障礙

## ◆ 近五年研究方向、主題

- ▶ 臺灣幼兒自閉症類群障礙的篩檢與追蹤(科技部104-105)
- ▶ 自閉類群障礙兒童的核心反應訓練：專業人員遠距學習計畫(科技部106-107)
- ▶ 自閉症類群兒童的居家治療服務計畫(科技部107-109)
- ▶ 雷特氏症患者的動作、行為與社交溝通發展之介入計畫初探(台灣大學109-110)
- ▶ 自閉症類群障礙兒童的節律動作介入計畫(台灣大學110-111)

# Complexity of Autism Spectrum Disorder (ASD)

## □ Prevalence rate increased rapidly

- **9,160 -> 15,439** (2010-2020) Taiwan National disability registry data
- **0.67% -> 1.85%** (2000-2018) 8-year-old American children
- **1%** of nationally school-aged children in Taiwan
- **0.28%** low treated prevalence from National Health Insurance program

## □ Lag time exists between the first concern and ASD diagnosis

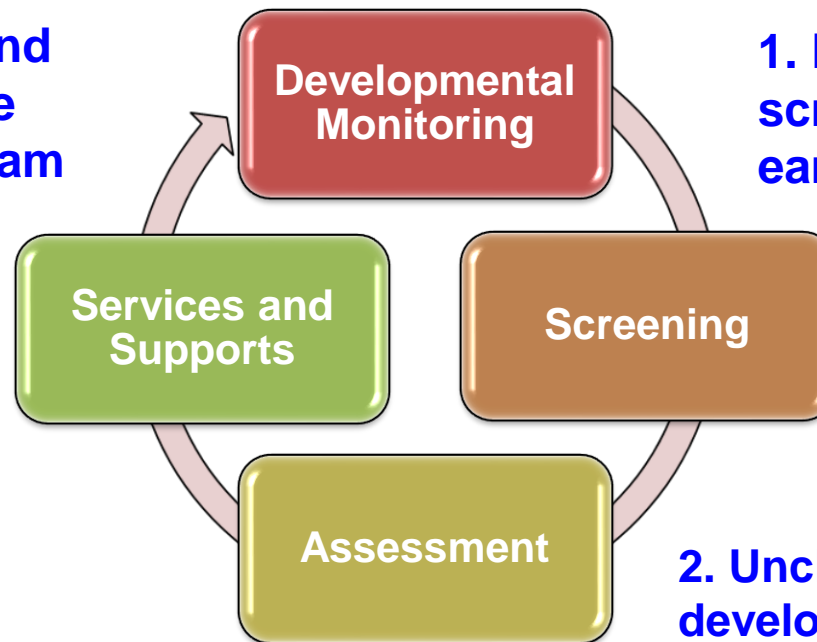
- Developmental regression **<2 years**, receive diagnosis at **>4 years**
- Low awareness and symptoms vary greatly
- Associated various developmental impairments



# Research Gaps of Early Services for Taiwanese Children with ASD

## Cycle of Developmental Health in Early Childhood (< Age 3)

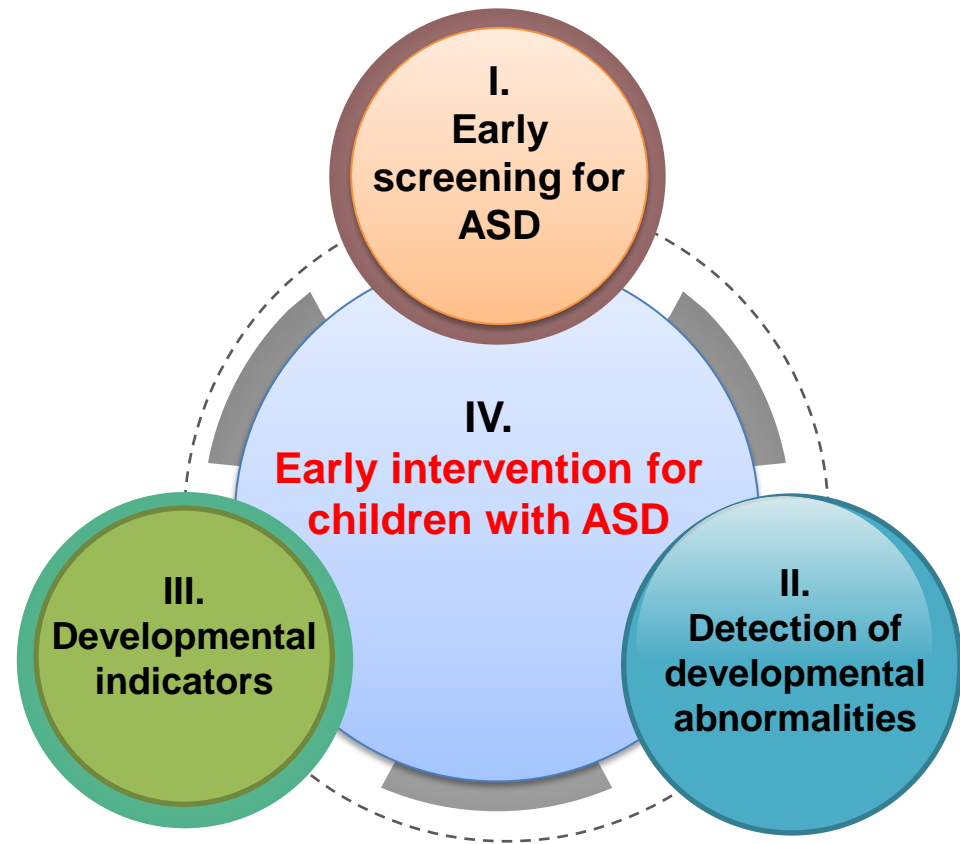
3. Less effective and culturally-sensitive intervention program



1. Few precise screening method for early detection

2. Unclear results of early developmental functioning in toddlers diagnosed with ASD

# Research Framework and Serial Studies



## Published papers:

### I. Tsai JM & Wu YT\* et al. 2019

Established valid screening method for ASD

### II. Yang YC & Wu YT\* et al. 2019

Detected multidimensional development in toddlers with ASD

### III. Wu YT\* et al. 2020

Relationship between motor skills and language abilities in toddlers with ASD

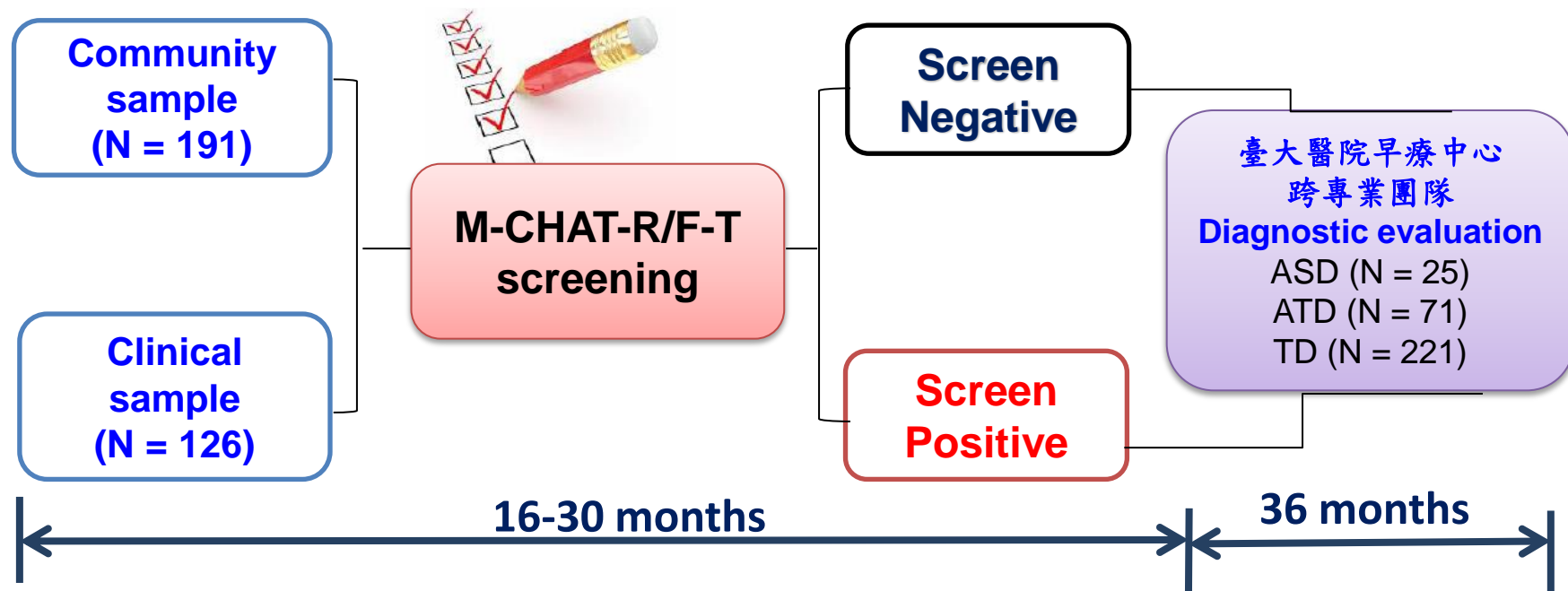
### IV. Huang YS & Wu YT\* et al. 2020

Development of a home-based service program for Children with ASD

# Part I: Validation of the M-CHAT-R/F-T in Taiwanese Toddlers (自閉症幼兒篩檢與追蹤修訂量表-臺灣版)

## Two-stage screening for the risks of ASD

- **1<sup>st</sup> stage:** parent-reported checklist for toddlers aged 16-30 months
- **2<sup>nd</sup> stage:** follow-up screen by professional interviews with parent



M-CHAT-R/F-T: The Modified Checklist for Autism in Toddlers- Revised with Follow-Up- Taiwan version  
ATD: atypically developing; TD: typically developing

## Part II: Examination of Multidimensional Developments in 30- to 36-Month-Old Taiwanese Toddlers With ASD

- Standardized assessments for cognitive, language, motor, behavioral development



**Mullen Scale of Early Learning (MSEL)**



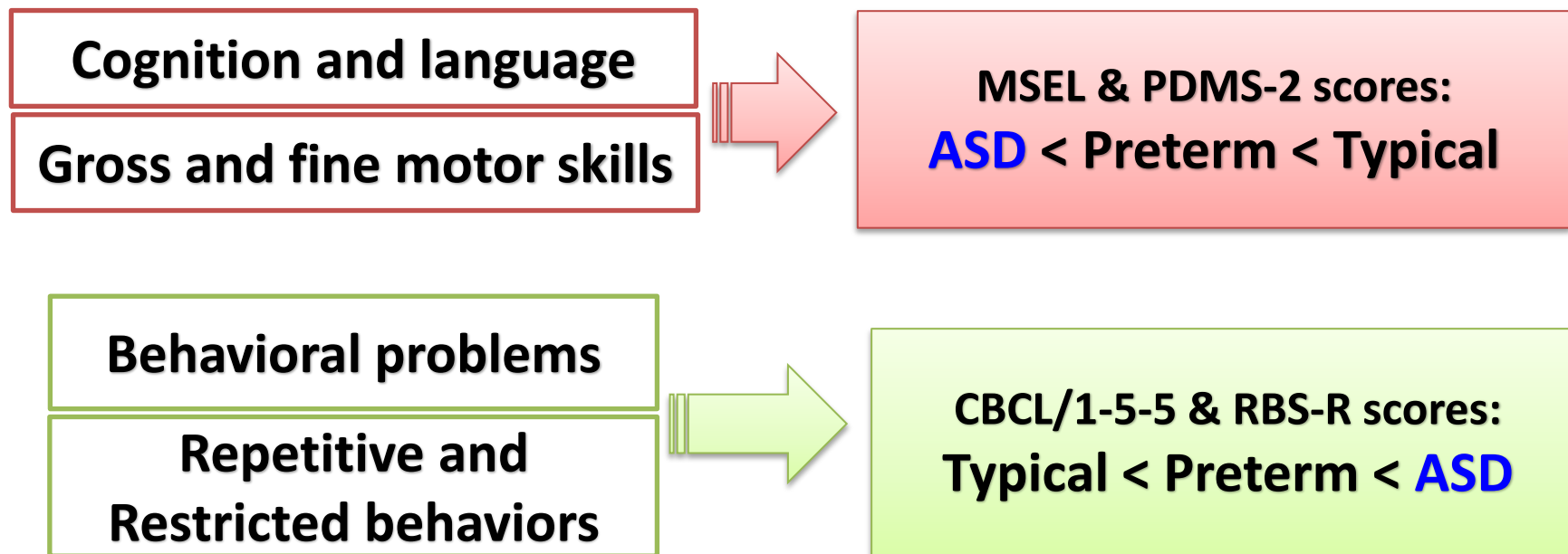
**Peabody Developmental Motor Scales, 2nd Edition (PDMS-2)**



- Child Behavior Checklist for Ages 1-1.5 (CBCL/1.5-5)
- Repetitive Behavior Scale-Revised (RBS-R)

# Results of Developmental Examinations in Taiwanese Toddlers with ASD

- Participants (N = 45): age-matched **full-term toddlers with ASD, preterm toddlers, typically-developing toddlers**

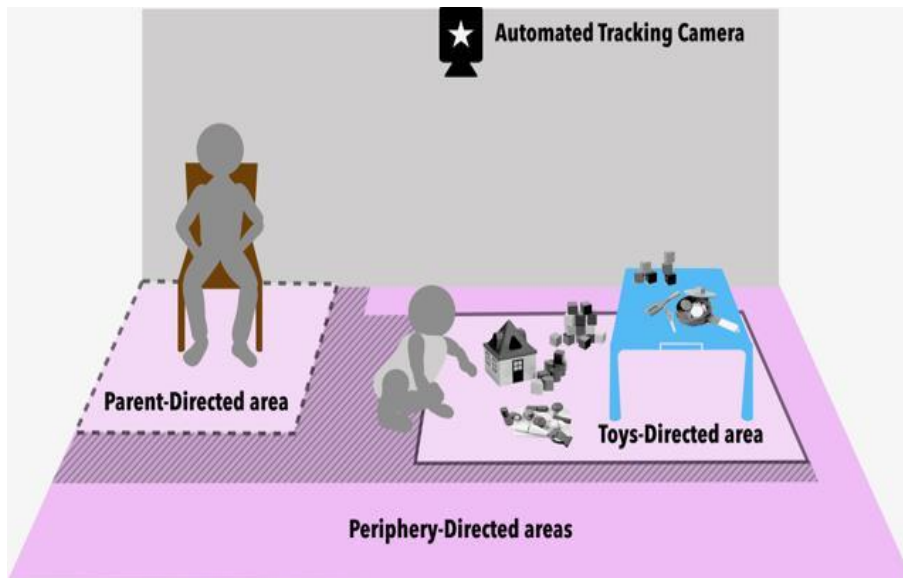




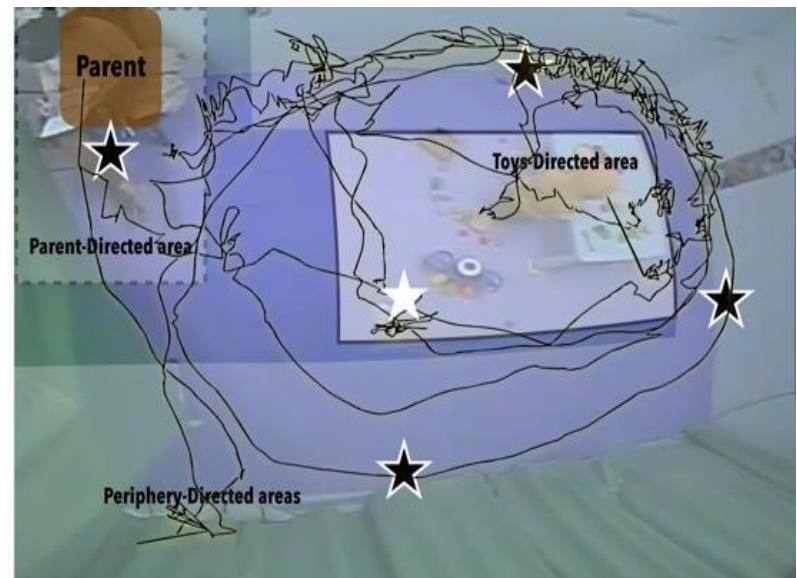
# Movement Tracking in Free-Play Laboratory Setting

## □ Automated Movement Tracking System (24 variables)

- **Moving variables**: moving time, distances, velocity by regions
  - **Turning**: frequency and angular velocity
- **Region of interest variables**: time staying in each region, frequency and latency of heading toward different region



Laboratory setting

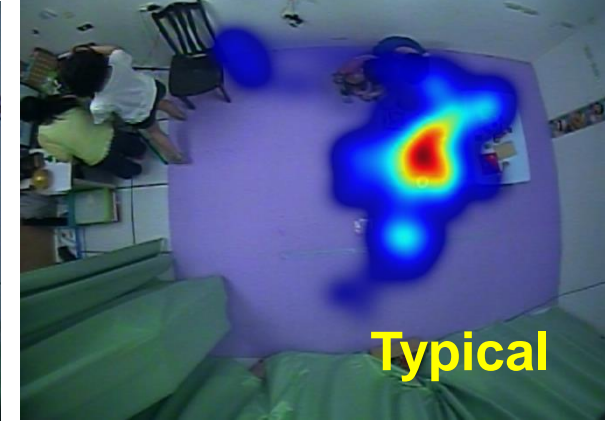
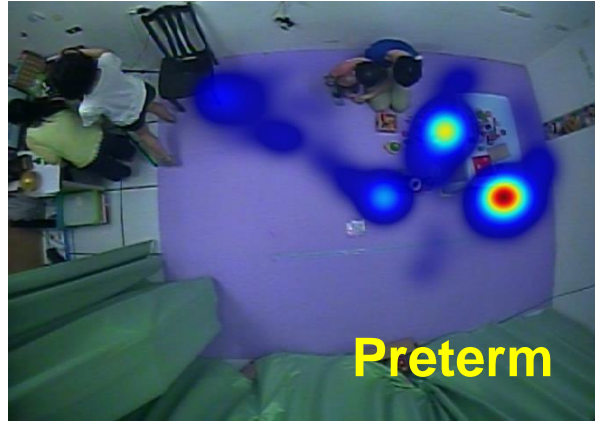
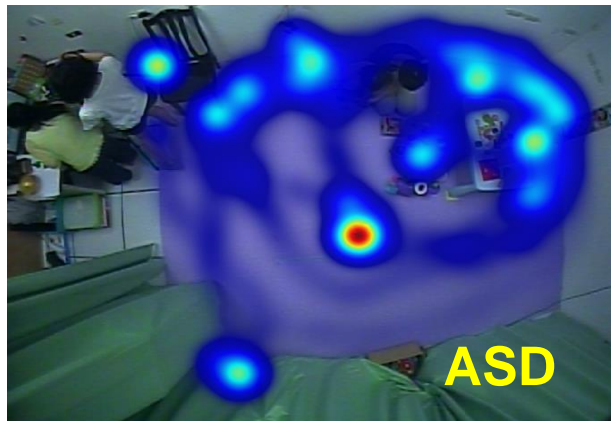


Moving trajectory

# Movement Tracking Indicators During Free Play

## ❑ Toddlers with ASD (vs. Preterm or Typical toddlers):

- Higher moving time and velocity in periphery and parent region
- Less moving time in toy region
- Higher turning angular velocity
- Higher interests staying in or heading to periphery region



- ◆ 10 movement tracking indicators correlated with cognitive and adaptive behavioral functioning ( $r = 0.52 - 0.59$ )

Yang YC, Lu L, Jeng SF, Tsao PN, Cheong PL, Li YJ, Wang SY, Huang HC, Wu YT\*. Multidimensional developments and free-play movement tracking in 30- to 36-month-old toddlers with autism spectrum disorder who were full term. *PHYSICAL THERAPY* 2019. NOV;99(11):1535-1550.

## **Part III: Relationship between Motor Skills and Language Abilities in Toddlers with ASD**

**Wu YT\*. PHYSICAL THERAPY 2021**

- ◆ **Toddlers with ASD exhibit various deficits in their receptive language (RL) and expressive language (EL) abilities**
- ◆ **Purpose: to explore the predictive correlation between motor functioning and language impairments in toddlers with ASD**
- ◆ **Age-matched toddlers with ASD (n=38) and typically developing toddler (n=38)**

## Mullen Scale of Early Learning: RL and EL subscales



# Peabody Developmental Motor Scales, 2nd Edition



Eigst et al. Research in Autism Spectrum Disorders. 2011;5(2):681-691.  
Su et al. Journal of autism and developmental disorders. 2018;48(10):3432-3448.  
Garrido et al. Autism Research. 2017;10(11):1737-1750.

- ◆ Toddlers with ASD exhibit various deficits in their receptive language (RL) and expressive language (EL) abilities



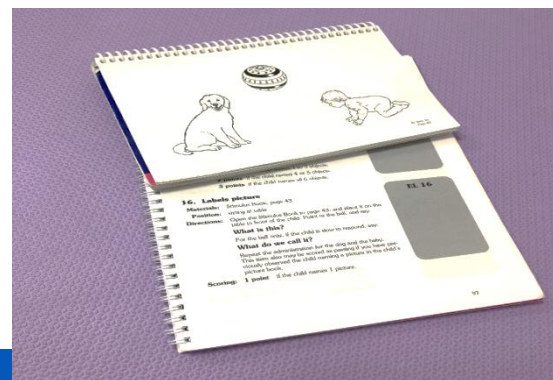
*Object Manipulation, Grasping  
Visual-Motor Integration  
Stationary, Locomotion*



**Correlation**

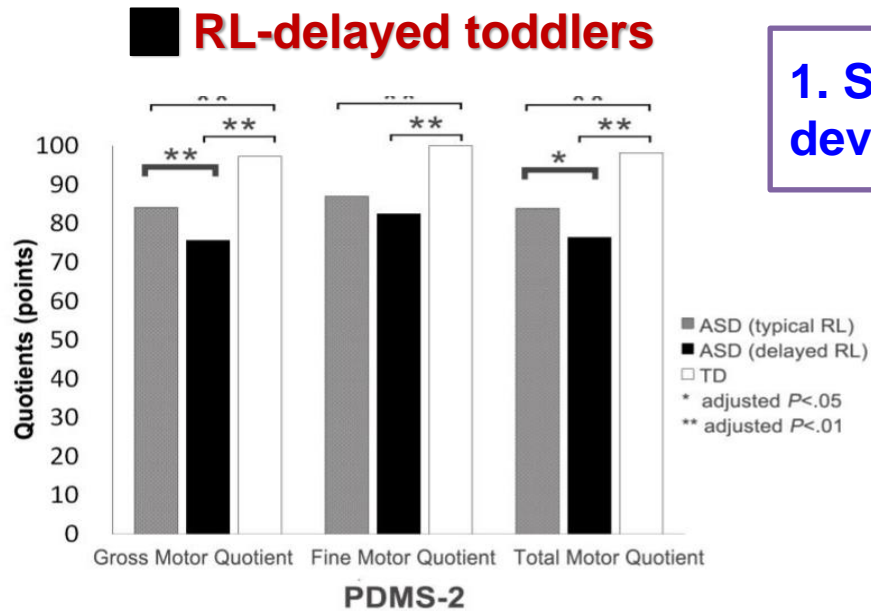


***RL/ EL impairment***





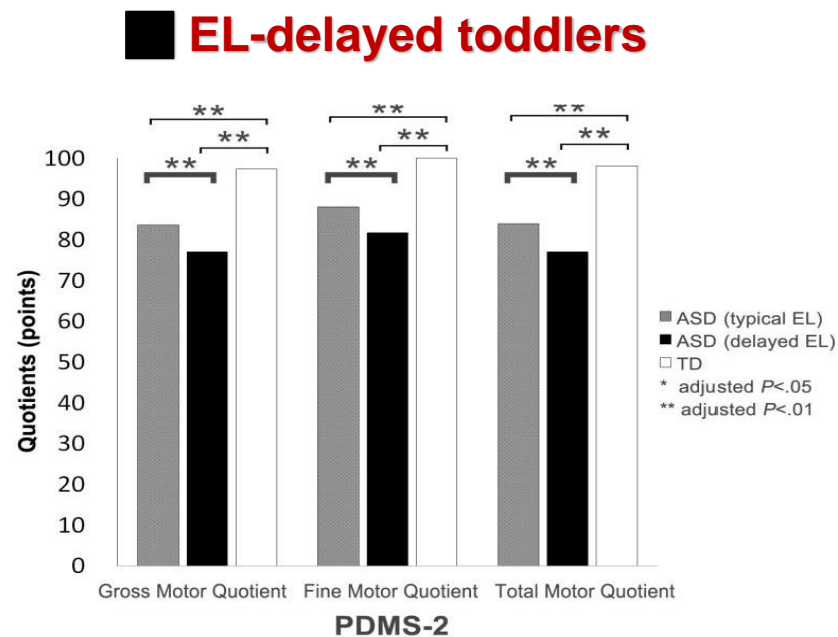
# Motor Skills and Language Abilities in Age-Matched Toddlers with ASD and Typical Toddlers (N = 76)



1. Significant correlations between two developmental functioning (RL > EL)

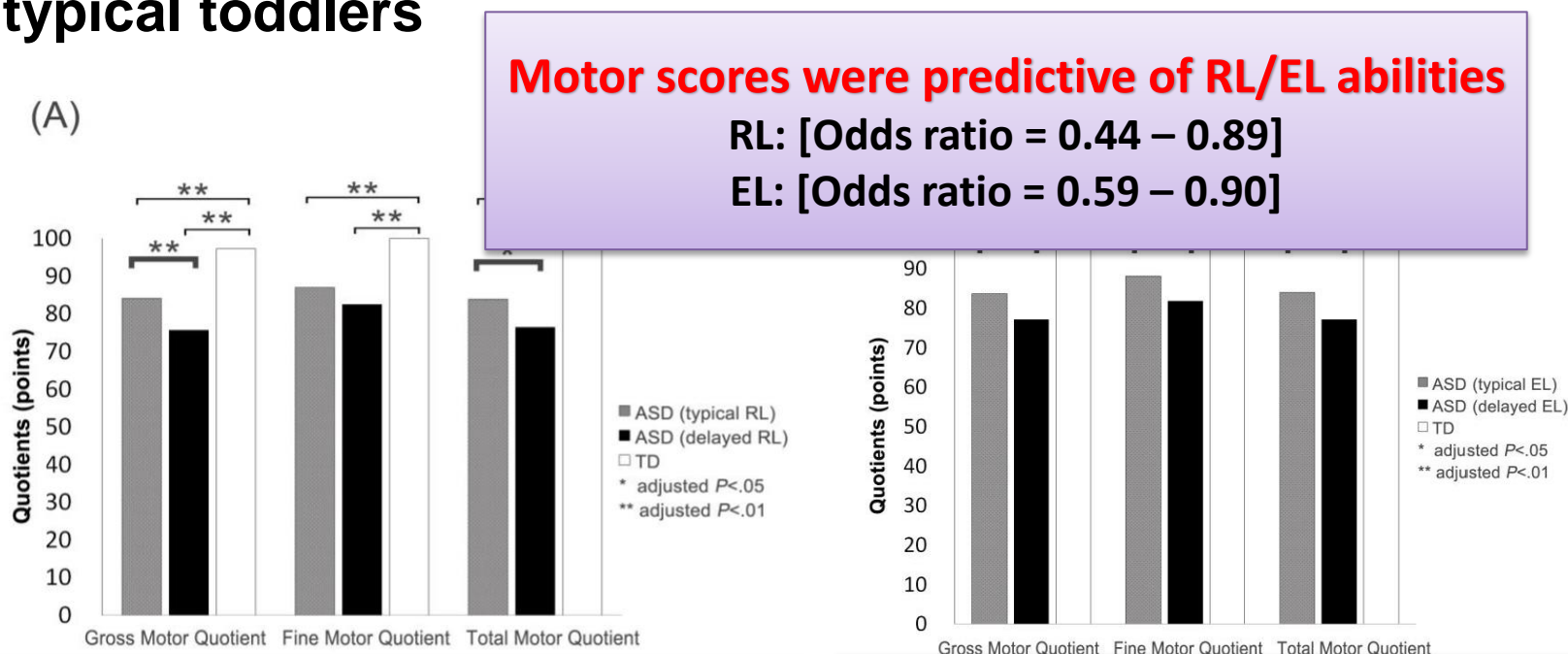
2. Higher motor scores were predictive of lower risk of RL/EL impairments (Odds ratios: 0.44-0.90)  
Specific motor functioning:

- **Object manipulation skills**
- **Visual-motor integration skills**



# Correlations Between Motor and Language scores

- Positive correlations with RL and EL scores ( $r = 0.38 - 0.55$ )
- More significant correlations in toddlers with ASD versus typical toddlers



**Motor scores**

**RL-delay ASD < RL-normal ASD < Typical**

**Motor scores**

**EL-delay ASD < EL-normal ASD < Typical**

# Delayed Development in Gesture and Motor Skills

<b>Deictic gestures / 指示手勢</b>	<b>10 months</b>	<b>showing, giving, pointing</b>
<b>Ritualized gestures / 儀式手勢</b>	<b>9-13 months</b>	<b>putting an adult's hand on an object</b>
<b>Recognitory gestures / 象徵手勢</b>	<b>12 months</b>	<b>drinking out of a toy cup</b>
<b>Iconic gestures / 圖解手勢</b>	<b>before 25 words</b>	<b>blowing to indicate bubbles, flapping one's arms to represent a bird</b>
<b>Communicative gesture / 溝通手勢 (Gesture + speech combinations)</b>	<b>18-24 months</b>	<b>pointing to a dog and saying "dog" pointing to a dog and saying "big"</b>

# 手勢動作和語言的共同發展

## 年齡 手勢發展

1-2歲 可以同時結合口語動作指出東西。  
用手勢展示一個物體的功能。  
18個月:即興互動中增加手勢運用。  
24個月:展現學習玩具的新玩法。

## 語言發展

每個月都可以說出更多的詞彙。  
可以使用些許一、兩個詞彙的問句（如：爸爸哪裡？這什麼？）。  
把兩個詞彙放在一起說，如：弟弟車車、吃餅乾。  
能說出許多不同子音（聲母）開頭的詞彙。  
2歲孩子能掌握150(75-225)個單詞



# 手勢動作多樣性、手勢和口語結合的數量

- 幼兒能有越多手勢表達物品及功能，相較於不太會比手勢的兒童，在年長時有較多的字彙量
  - 手勢的“**意義多樣性**”越高，可以預測較高的單字量
  - 運用手勢跟單字的結合次數越高，與句型複雜程度具高度相關

(Rowe 2009; Blake, 2000; Salo 2018)

Symbolic gestures → Pointing with word-object pairings →  
Word-object relations →  
vocabulary and conceptual development

## **The impact of object and gesture imitation training on language use in children with autism**

**Brooke Ingersoll, Ph.D. and Katherine Lalonde, B.A.**  
Michigan State University

- ◆ **Therapist taught gesture imitation by modeling a gesture related to the child's play.**
  - ▶ If the child was spinning the wheels of the car, the therapist might model a spinning gesture, while saying “Spin, spin” or might model a driving gesture, while saying “It’s a car.”
- ◆ **Greater improvements in their use of appropriate language after gesture imitation training.**

Article

## A Pivotal Response Treatment Package for Children With Autism Spectrum Disorder: An RCT

Grace W. Gengoux, Daniel A. Abrams, Rachel Schuck, Maria Estefania Millan, Robin Libove, Christina M. Ardel, Jennifer M. Phillips, Melanie Fox, Thomas W. Frazier and Antonio Y. Hardan

Pediatrics September 2019, 144 (3) e20190178; DOI: <https://doi.org/10.1542/peds.2019-0178>

<https://pediatrics.aappublications.org/content/144/3/e20190178.long>

Combination of language and gesture training

- “Up and Down”
- “Jump jump jump”

# 自閉類群障礙兒童的應用

- 手勢動作發展評估是三歲前需要的評估觀察，它可以幫助了解自閉症兒童的手勢與溝通能力、語言障礙程度，與決定介入策略
- 研究顯示自閉症兒童可以透過學習模仿手勢與提升動作技巧，幫助運用社交溝通技巧。

(Mastrogioseppe 2015; Whalen 2006)

# 合併手勢動作語的介入策略

- 「手勢動作語」對於學語言初期的幼兒，在誘發其語言上具有實質效益。
  - Using gesture strategy during training were more likely to learn than children who used a speech strategy alone  
(Dunst 2012; Novak 2015)
- 早療的治療師和教育者可以在教學中搭配手勢(特別在沒有教具的情況下)。
  - 鼓勵孩童以手勢表達意見
  - 增加孩童注意力
  - 幫助理解口語資訊，增加孩童的手勢運用  
(Wakefield 2015)

# Implications and Future Study

## □ Implications

- Early screening for ASD in toddlers
- Early assessment of motor delays and movement-based problems in toddlers with ASD
- Development of motor-oriented interventions that could target language abilities among toddlers with ASD.



## □ Future aspects

- Longitudinal observation on motor developments from early to middle childhood.
- Development of effective motor intervention program
- Neural mechanisms of motor intervention and intervention effects

# Acknowledgments

## □ 科技部、臺灣大學研究計畫

- 臺灣幼兒自閉症類群障礙的篩檢與追蹤
- 自閉類群障礙兒童的核心反應訓練:專業人員遠距學習計畫
- 自閉症類群兒童的居家治療服務計畫
- 雷特氏症患者的動作、行為與社交溝通發展之介入計畫初探

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