How to read a research paper

Asynchronous video slides

Manasi Jayakumar

Slides adapted from a SIPPS 2022 workshop co-taught with Claudia Espinoza-Heredia

Lesson Plan

- ➔ What does a research paper look like?
- ➔ Important parts of a research paper
- ➔ Taking notes on a research paper
- ➔ Some tips for reading papers

What does a research paper look like?

Empirical papers

- ➔ Original experiments or data analysis
- ➔ Sections:
  - ◆ Abstract
  - ◆ Introduction
  - ◆ Methods
  - ◆ Results
  - ◆ Discussion

Review papers

- ➔ Summary and evaluation of papers that have been published in the field
- ➔ Present:
  - ◆ Theory or theoretical framework
  - ◆ Gaps in knowledge and suggestions for future research

Review Papers

Psychonomic Bulletin and Review (2019) 26:699–720
https://doi.org/10.3758/s13423-018-1537-3

THEORETICAL REVIEW

Contiguity in episodic memory

M. Karl Healey[1] · Nicole M. Long[2] · Michael J. Kahana[3]

Published online: 21 November 2018

Abstract
Contiguity is one of the major predictors of recall dynamics in human episodic memory. But there are many competing theories of how the memory system gives rise to contiguity. Here we provide a set of benchmark findings for which any such theory should account. These benchmarks are drawn from a review of the existing literature as well as analyses of both new and archival data. They include 34 distinct findings on how various factors including individual and group differences, task parameters, and type of stimuli influence the magnitude of the contiguity effect. We will see that contiguity is observed in a range of tasks including recognition, paired associates, and autobiographical recall and across a range of time scales including minutes, days, weeks, and years. The broad pattern of data point toward a theory in which contiguity arises from fundamental memory mechanisms that encode and search an approximately time scale invariant representation of temporal distance.

Keywords Episodic memory · Free recall · Recognition · Paired associates · Temporal contiguity

Recall of one event often evokes memories of other events that occurred nearby in time. In the laboratory, this *temporal contiguity effect* is observed when subjects study and then recall lists of words: the order in which they recall the words tends to be similar to the original presentation order (for early reviews, see Postman 1971, 1972). Here we provide an overview of what we currently know about the contiguity effect by presenting 34 findings concerning how the effect is influenced by various factors and manipulations. Some of these come from a review of previous work, others are novel findings from the Penn Electrophysiology of Encoding and Retrieval Study (PEERS Healey & Kahana, 2014; Lohnas & Kahana, 2014; Miller, Kahana, & Weidemann, 2012; see Appendix A for methods). Our overview is divided into seven sections: basic properties of the contiguity effect in free recall, individual and group differences, manipulations of task parameters, manipulations of stimuli, manipulations of encoding tasks, contiguity in other memory tasks, and contiguity at long time scales. Table 1 lists the 34 findings we will discuss and their original references. We conclude with an evaluation of the ability of six different memory mechanisms to account for the findings: associative chaining, short-term memory, positional coding, chunking, contextual dynamics, and control processes.

Basic properties of the contiguity effect in free recall

Available online at www.sciencedirect.com
ScienceDirect
Current Opinion in Behavioral Sciences
ELSEVIER

The ebb and flow of experience determines the temporal structure of memory

David Clewett and Lila Davachi

Everyday life consists of a continuous stream of information, yet somehow we remember the past as distinct episodic events. Prominent models posit that event segmentation is driven by erroneous predictions about how current experiences are unfolding. Yet this perspective fails to explain how memories become integrated or separated in the absence of prior knowledge. Here, we propose that contextual stability dictates the temporal organization of events in episodic memory. To support this view, we summarize new findings showing that neural measures of event organization index how ongoing changes in external contextual cues and internal representations of time influence different forms of episodic memory.

Address
Department of Psychology, New York University, USA

Corresponding author: Davachi, Lila (lila.davachi@nyu.edu)

Current Opinion in Behavioral Sciences 2017, **17**:186–193

This review comes from a themed issue on **Memory in time and space**

Edited by **Lila Davachi** and **Neil Burgess**

For a complete overview see the Issue and the Editorial

Available online 3rd October 2017

http://dx.doi.org/10.1016/j.cobeha.2017.08.013

Introduction

> "*Time is a sort of river of passing events, and strong is its current; no sooner is a thing brought to sight than it is swept by and another takes its place, and this too will be swept away.*" -Marcus Aurelius (c. 161–180 AD)

For millennia, the notion that moment-to-moment experiences unfold like a flowing river has been central to our conceptualizations of time. Yet while we experience the world through a constant stream of information, we usually remember those experiences as being more discrete and discontinuous, broken down into individual episodes, or memories. This raises two fundamental yet often unasked questions: *What makes an episode in episodic memory? How do we represent time and extract information about events embedded within it?*

Prior memory research has largely focused on examining the processes that contribute to successful encoding of individual trial information, such as single images or single item-context associations. In the real world, however, more complex modes of memory clustering are necessary to derive meaning from past experiences. Growing evidence indicates that such memory organization has reliable consequences not only for later event recall and recognition of individual items [1–4] but also for how the temporal, or sequential, aspects of events are remembered [5••,6,7,8•,9,64]. Thus, discerning the cognitive and neural processes by which we organize, structure, and remember events is essential to promoting a deeper understanding of how our memory systems contribute to adaptive behavior.

Prominent models of event cognition posit that ongoing sensory inputs are segmented into events when our expectations about the current environment conflict with what is happening, leading to prediction errors [10,11]. From this perspective, prior knowledge enables inferences to be made about the structure of specific sequences of information, or events [12]. For instance, participants tend to agree on natural breakpoints in videos of familiar everyday activities, such as washing a car [10]. However, this prediction error account of event segmentation is incomplete (Box 1). While prior experience may call to mind and reinforce the temporal structure of familiar events, we cannot rely fully on predictions garnered from past experiences to parse novel sequences of information. Further, recent empirical work shows that foreshadowing impending event shifts during reading comprehension still leads to slower reading times, suggesting that expectations do not prevent event segmentation processes from occurring [13]. Most segmentation and memory studies have also focused overwhelmingly on recognition memory [4,14–17]. In so doing, they obscure the simple fact that episodic memories are primarily characterized by their rich sequential and contextual information [18].

In this short review, we argue that fluctuations in contextual stability — including changes in stimulus features, goal states, or internal representations of time — fundamentally shape the temporal organization of events in episodic memory. To support this view, we summarize evidence that even the simplest transitions between contexts during sequence learning modulate behavioral and neural encoding/retrieval processes in ways that can both form and distinguish unique episodic events across time.

Empirical Papers

Atten Percept Psychophys (2013) 75:426–439
DOI 10.3758/s13414-012-0413-x

Sustaining visual attention in the face of distraction: a novel gradual-onset continuous performance task

Monica Rosenberg · Sarah Noonan · Joseph DeGutis · Michael Esterman

We created a novel task, the gradual-onset CPT (gradCPT), to address our aims of better characterizing performance decrements over time, moment-to-moment fluctuations in RTs, and individual differences in sustained attention. The gradCPT represents a unique combination of task features, in that it both requires frequent overt responses and removes abrupt stimulus onsets that may exogenously capture attention. By using an analysis method that explores within-subjects fluctuations in RT variability during gradCPT performance, we exploited a higher-resolution and more continuous measure of attention than response accuracy. We hypothesized that the gradCPT would elicit performance decrements over time in both accuracy and RT variability. Furthermore, we hypothesized that fluctuations in RT variability would interact with error proneness, potentially revealing different attentional states and shedding light on distinct causes for errors. In addition, to examine the potential effect of distraction on the relationship between task performance and individual-difference measures, some participants performed the gradCPT with visual distraction in the background of the central task. We predicted that background distractors would potentially interfere with performance, causing more frequent errors and increased RT variability, and that, importantly, individual differences in self-reported mindfulness and everyday attention lapses (as measured by ARCES and MAAS) would be more strongly related to gradCPT performance in the presence of distractors.

RESEARCH ARTICLE

Pupil Diameter Tracks Lapses of Attention

Ruud L. van den Brink[1,2]*, Peter R. Murphy[1,2,3], Sander Nieuwenhuis[1,2]

1 Institute of Psychology, Leiden University, Leiden, the Netherlands, **2** Leiden Institute for Brain and Cognition (LIBC), Leiden, the Netherlands, **3** Department of Neurophysiology and Pathophysiology, University Medical Center Hamburg-Eppendorf, Hamburg, Germany

* r.l.van.den.brink@fsw.leidenuniv.nl

Abstract

Our ability to sustain attention for prolonged periods of time is limited. Studies on the relationship between lapses of attention and psychophysiological markers of attentional state, such as pupil diameter, have yielded contradicting results. Here, we investigated the relationship between tonic fluctuations in pupil diameter and performance on a demanding sustained attention task. We found robust linear relationships between baseline pupil diameter and several measures of task performance, suggesting that attentional lapses tended to occur when pupil diameter was small. However, these observations were primarily driven by the joint effects of time-on-task on baseline pupil diameter and task performance. The linear relationships disappeared when we statistically controlled for time-on-task effects and were replaced by consistent inverted U-shaped relationships between baseline pupil diameter and each of the task performance measures, such that most false alarms and the longest and most variable response times occurred when pupil diameter was both relatively small and large. Finally, we observed strong linear relationships between the temporal derivative of pupil diameter and task performance measures, which were largely independent of time-on-task. Our results help to reconcile contradicting findings in the literature on pupil-linked changes in attentional state, and are consistent with the adaptive gain theory of locus coeruleus-norepinephrine function. Moreover, they suggest that the derivative of baseline pupil diameter is a potentially useful psychophysiological marker that could be used in the on-line prediction and prevention of attentional lapses.

Important parts of an empirical paper

- ➔ Introduction
  - Big picture question:
    Big questions in the field that cannot be answered with just one experiment/paper
  - What informs this current work?
    Summary of previous literature - What do we know? What are the gaps?
  - Specific hypothesis
    What exactly are you testing here?

Important parts of an empirical paper

- ➔ Methods
  - ◆ Participants

    Sample (healthy participants, clinical population etc.), age range, etc.
  - ◆ Variables
    - IV (aka Predictor variable)
    - DV (aka Outcome variable)
  - ◆ Assessments, tests, or other procedures

Important parts of a paper

- ➔ Results
  - Main finding
    Finding that relates back to the specific hypothesis
  - Secondary finding
    Other findings that either talk about secondary variables, or other confounds in the data

Important parts of a paper

- ➔ Discussion
  - What did they answer?
  - Any other unanswered questions?
  - Future work:
    Resolving confounds, or other ways to test the same hypothesis.

Unanswered questions and future work may not always be explicit in the paper. Think critically about these once you understand the paper.

Take notes as you go

- ➔ Literature Review Table (recommended)
- ➔ Literature Review Outline
- ➔ Paper Notes (organized written/typed notes)
- ➔ Casual Notes (organize it later)

Literature Review Table

A	B	C
first author ... last author (year)	**sample (who are the Ps? number of Ps?)**	**independent variable(s) (i.e. predictors)**

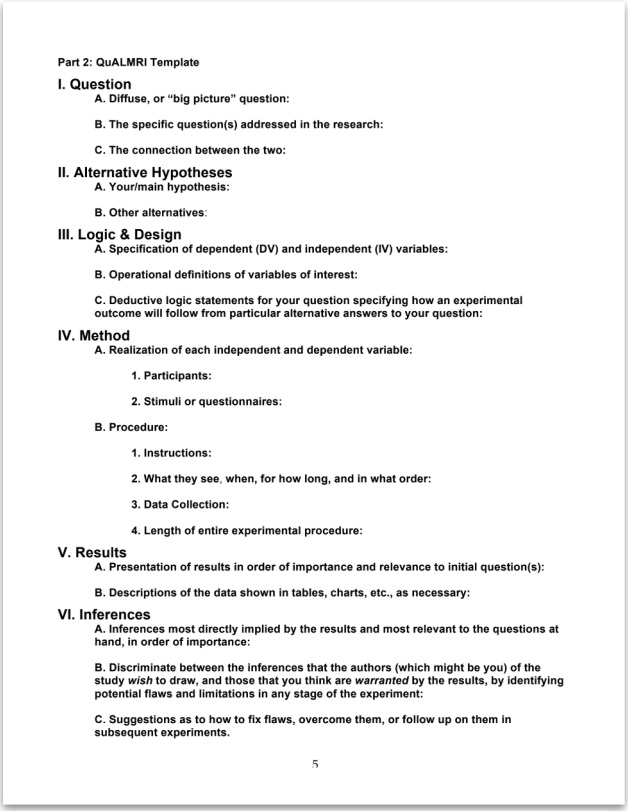
D	E	F
dependent variable(s) (i.e. outcome)	**other relevant variables (e.g., covariates)**	**study design/procedures (what did they do?)**

G	H	I
main results/findings	**any other important findings?**	**comments aboout paper**

Literature Review Outline

QuALMRI:
Framework adapted from Kevin Ochsner, based on a scheme devised by Steve Kosslyn

- ➔ **Qu**estion,
- ➔ **A**lternative hypotheses,
- ➔ **L**ogic & design,
- ➔ **M**ethod,
- ➔ **R**esults,
- ➔ **I**nferences.



Part 2: QuALMRI Template

I. Question
- A. Diffuse, or "big picture" question:
- B. The specific question(s) addressed in the research:
- C. The connection between the two:

II. Alternative Hypotheses
- A. Your/main hypothesis:
- B. Other alternatives:

III. Logic & Design
- A. Specification of dependent (DV) and independent (IV) variables:
- B. Operational definitions of variables of interest:
- C. Deductive logic statements for your question specifying how an experimental outcome will follow from particular alternative answers to your question:

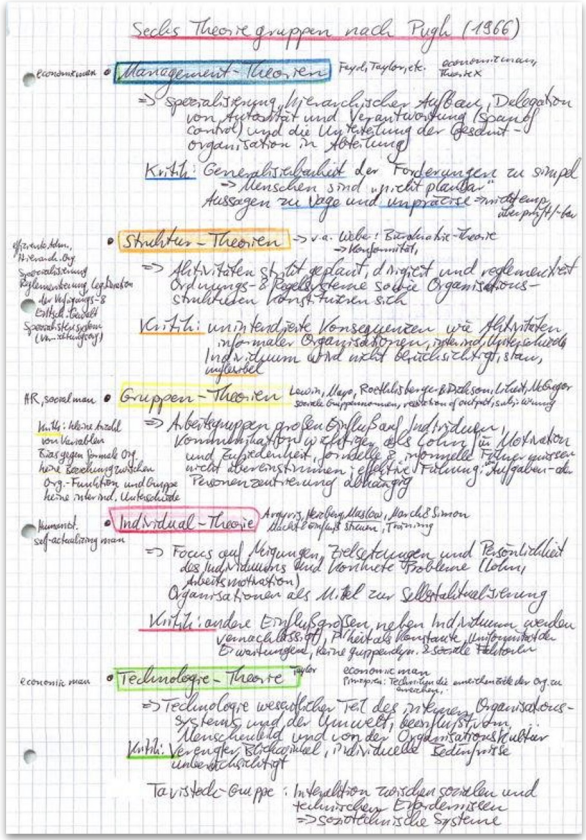
IV. Method
- A. Realization of each independent and dependent variable:
  - 1. Participants:
  - 2. Stimuli or questionnaires:
- B. Procedure:
  - 1. Instructions:
  - 2. What they see, when, for how long, and in what order:
  - 3. Data Collection:
  - 4. Length of entire experimental procedure:

V. Results
- A. Presentation of results in order of importance and relevance to initial question(s):
- B. Descriptions of the data shown in tables, charts, etc., as necessary:

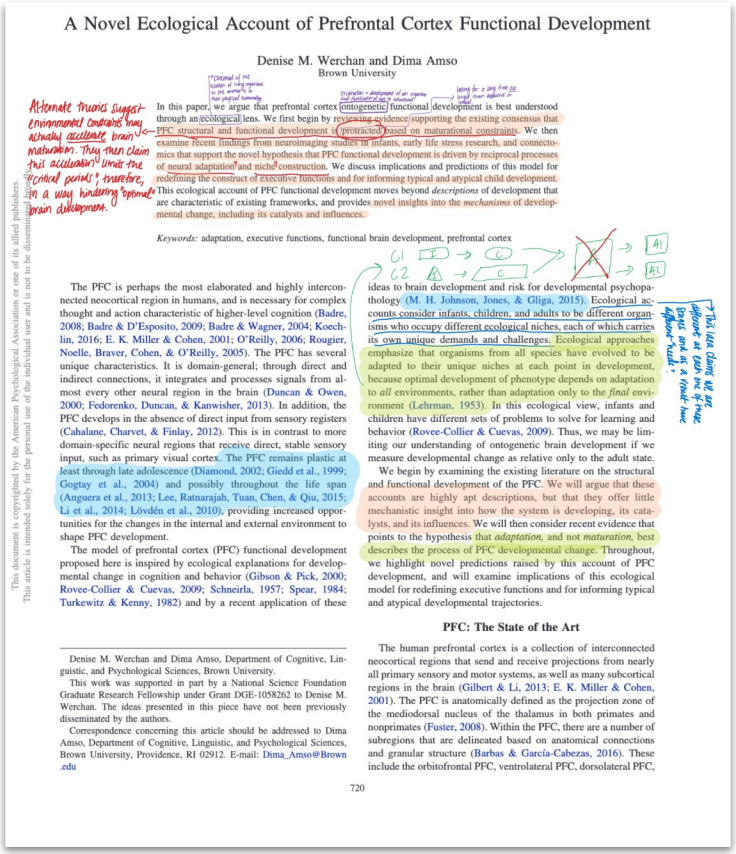
VI. Inferences
- A. Inferences most directly implied by the results and most relevant to the questions at hand, in order of importance:
- B. Discriminate between the inferences that the authors (which might be you) of the study *wish* to draw, and those that you think are *warranted* by the results, by identifying potential flaws and limitations in any stage of the experiment:
- C. Suggestions as to how to fix flaws, overcome them, or follow up on them in subsequent experiments.

5

Paper (Hand-written) Notes



Casual Notes (subsequent organization)



A Novel Ecological Account of Prefrontal Cortex Functional Development

Denise M. Werchan and Dima Amso
Brown University

In this paper, we argue that prefrontal cortex ontogenetic functional development is best understood through an ecological lens. We first begin by reviewing evidence supporting the existing consensus that PFC structural and functional development is protracted based on maturational constraints. We then examine recent findings from neuroimaging studies in infants, early life stress research, and connectomics that support the novel hypothesis that PFC functional development is driven by reciprocal processes of neural adaptation and niche construction. We discuss implications and predictions of this model for redefining the construct of executive functions and for informing typical and atypical child development. This ecological account of PFC functional development moves beyond *descriptions* of development that are characteristic of existing frameworks, and provides novel insights into the *mechanisms* of developmental change, including its catalysts and influences.

Keywords: adaptation, executive functions, functional brain development, prefrontal cortex

The PFC is perhaps the most elaborated and highly interconnected neocortical region in humans, and is necessary for complex thought and action characteristic of higher-level cognition (Badre, 2008; Badre & D'Esposito, 2009; Badre & Wagner, 2004; Koechlin, 2016; E. K. Miller & Cohen, 2001; O'Reilly, 2006; Rougier, Noelle, Braver, Cohen, & O'Reilly, 2005). The PFC has several unique characteristics. It is domain-general; through direct and indirect connections, it integrates and processes signals from almost every other neural region in the brain (Duncan & Owen, 2000; Fedorenko, Duncan, & Kanwisher, 2013). In addition, the PFC develops in the absence of direct input from sensory registers (Cahalane, Charvet, & Finlay, 2012). This is in contrast to more domain-specific neural regions that receive direct, stable sensory input, such as primary visual cortex. The PFC remains plastic at least through late adolescence (Diamond, 2002; Giedd et al., 1999; Gogtay et al., 2004) and possibly throughout the life span (Anguera et al., 2013; Lee, Ratnarajah, Tuan, Chen, & Qiu, 2015; Li et al., 2014; Lövdén et al., 2010), providing increased opportunities for the changes in the internal and external environment to shape PFC development.

The model of prefrontal cortex (PFC) functional development proposed here is inspired by ecological explanations for developmental change in cognition and behavior (Gibson & Pick, 2000; Rovee-Collier & Cuevas, 2009; Schneirla, 1957; Spear, 1984; Turkewitz & Kenny, 1982) and by a recent application of these ideas to brain development and risk for developmental psychopathology (M. H. Johnson, Jones, & Gliga, 2015). Ecological accounts consider infants, children, and adults to be different organisms who occupy different ecological niches, each of which carries its own unique demands and challenges. Ecological approaches emphasize that organisms from all species have evolved to be adapted to their unique niches at each point in development, because optimal development of phenotype depends on adaptation to *all* environments, rather than adaptation only to the *final* environment (Lehrman, 1953). In this ecological view, infants and children have different sets of problems to solve for learning and behavior (Rovee-Collier & Cuevas, 2009). Thus, we may be limiting our understanding of ontogenetic brain development if we measure developmental change as relative only to the adult state.

We begin by examining the existing literature on the structural and functional development of the PFC. We will argue that these accounts are highly apt descriptions, but that they offer little mechanistic insight into how the system is developing, its catalysts, and its influences. We will then consider recent evidence that points to the hypothesis that *adaptation*, and not *maturation*, best describes the process of PFC developmental change. Throughout, we highlight novel predictions raised by this account of PFC development, and will examine implications of this ecological model for redefining executive functions and for informing typical and atypical developmental trajectories.

PFC: The State of the Art

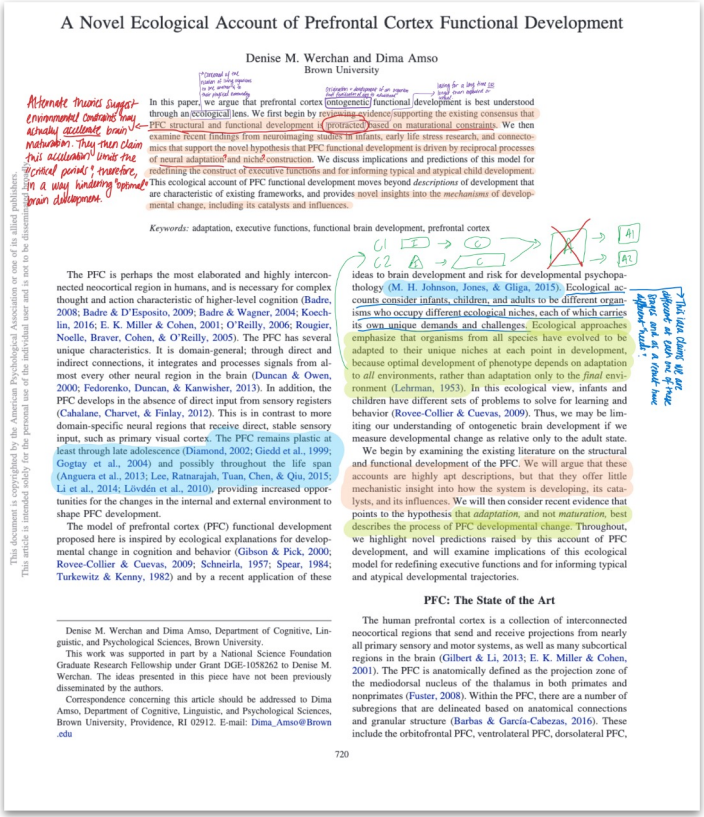
The human prefrontal cortex is a collection of interconnected neocortical regions that send and receive projections from nearly all primary sensory and motor systems, as well as many subcortical regions in the brain (Gilbert & Li, 2013; E. K. Miller & Cohen, 2001). The PFC is anatomically defined as the projection zone of the mediodorsal nucleus of the thalamus in both primates and nonprimates (Fuster, 2008). Within the PFC, there are a number of subregions that are delineated based on anatomical connections and granular structure (Barbas & García-Cabezas, 2016). These include the orbitofrontal PFC, ventrolateral PFC, dorsolateral PFC,

Denise M. Werchan and Dima Amso, Department of Cognitive, Linguistic, and Psychological Sciences, Brown University.

This work was supported in part by a National Science Foundation Graduate Research Fellowship under Grant DGE-1058262 to Denise M. Werchan. The ideas presented in this piece have not been previously disseminated by the authors.

Correspondence concerning this article should be addressed to Dima Amso, Department of Cognitive, Linguistic, and Psychological Sciences, Brown University, Providence, RI 02912. E-mail: Dima_Amso@Brown.edu

Casual Notes (subsequent organization)



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Coding for Cultural Variability in COMBO Data Set Lit Review

1 - ***CULTURAL DIFFERENCES IN MATERNAL BELIEFS AND BEHAVIORS: A STUDY OF MIDDLE-CLASS ANGLO AND PUERTO RICAN MOTHER-INFANT PAIRS IN FOUR EVERYDAY SITUATIONS.
Harwood, R. L., Schoelmerich, A., Schulze, P. A., & Gonzalez, Z. (1999). Cultural differences in maternal beliefs and behaviors: A study of middle-class Anglo and Puerto Rican mother-infant pairs in four everyday situations. Child Development, 70(4), 1005-1016.

SUMMARY
Here they explored cultural differences in PR and US middle-class mother-infant dyads via interviews and video recordings of 4 everyday situational interactions to grasp maternal beliefs and childrearing practices. They used previously developed categories to code behaviors: (a) Self-Maximization, (b) Self-control, (c) Lovingness, (d) Decency, and (e) Proper Demeanor. They found only one gender difference among all analyses. Study results were consistent with previous works demonstrating that Anglo cultural beliefs were more individualistic, and they were more likely to generate socializing goals promoting Self-Maximization and Self-Control. Puerto Rican beliefs were more sociocentric and they geared their socialization goals around Proper Demeanor and Decency.

QUESTION

- **A. Diffuse or "big picture" question:**
  More specifically, if childhood's cultural context is indeed patterned at a broad level, then how do we understand and represent internal variations in parental beliefs and practices?

- **B. The specific questions addressed in the research:**
  In this study, we sought to investigate the cultural patterning of situational variability in mother-infant interactions.

- **C. The connection between the two:**
  Identifying cultural variability in parenting by observing mother-infant interactions

HYPOTHESES

- **A. Main hypotheses:**
  1. Groups will vary by emphasizing sociocentric orientation and others individualistic orientation.
  2. Anglo mothers = encourage independence
     PR mothers = encourage respectfulness and attentiveness to others
- **B. Other alternative hypotheses:**
  1. Cultural patterning will be consistent with mothers' long-term socialization goals

DESIGN

- **D. Dependent Variable**
  Child Self-Maximization, Self-Control, Proper Demeanor, Decency
- **E. Independent Variable**
  Maternal parenting Verbal and Non-verbal behaviors
  Secondary: Mother long-term socialization goals

Take notes as you go

- ➔ **Literature Review Table (recommended)**
- ➔ Literature Review Outline
- ➔ Paper Notes (organized written/typed notes)
- ➔ Casual Notes (organize it later)

Some tips for reading papers

- **You don’t have to read everything thoroughly**
- **You don’t have to read in order (can pick and choose based on why you are reading the paper)**
- Think about the purpose behind reading the paper and tackle it accordingly
- Reading as part of the lit review for a research question:
  - Skim first
  - Read to get an overall understanding while taking notes (what, why, how)
- Reading for Journal Club or a seminar class:
  - Skim first,
  - Read while taking notes to get an overall understanding
  - Read in depth and think through the paper so you can critique it

How I read papers

- ➔ Read the last paragraph(s) of the introduction to understand the question and the hypotheses
- ➔ Skim the methods (particularly the figure with the design)
- ➔ Skim the results (particularly the figure with the main results)
- ➔ Read the discussion thoroughly, where the results are reviewed in plain language
- ➔ Go back to methods and results, and re-read to get a complete sense of the paper
  - ◆ Design considerations
  - ◆ Statistical analyses for main findings
  - ◆ Control analyses

Critiquing papers

- ➔ Was the purpose and importance of the study clear?
- ➔ Were the hypotheses theoretically sound and clearly stated?
- ➔ Does the design make sense? Will it allow the authors to test the question? Could it be improved?
- ➔ Were the proper statistical approaches used to answer the questions?
- ➔ Were the conclusions drawn appropriate? Could there be any alternate explanations for the results?
- ➔ How do the results fit in with the broader idea of the paper?
- ➔ Was the discussion clear? Did it synthesize the paper well? Did it make sense of contradictory or non-significant findings?

http://labs.psychology.illinois.edu/~lyubansk/Method/rmcritique.htm