How to read a research paper

Claudia Espinoza-Heredia & Manasi Jayakumar

SIPPS 2022 Workshop - June 15, 2022

Outline of today’s workshop

1. What does a research paper look like?
2. Important parts of a research paper
3. Taking notes on a research paper
4. Example of a paper breakdown

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

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.

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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

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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]

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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

1. Introduction
    a. Big picture question:
       Big questions in the field that cannot be answered with just one experiment/paper
    b. What informs this current work?
       Summary of previous literature - What do we know? What are the gaps?
    c. Specific hypothesis
       What exactly are you testing here?
2. Methods
    a. Participants
       Sample (healthy participants, clinical population etc.), age range, etc.
    b. Variables
        i. IV (aka Predictor variable)
        ii. DV (aka Outcome variable)
    c. Assessments, tests, or other procedures

Important parts of a paper

3. Results
    a. Main finding
       Finding that relates back to the specific hypothesis
    b. Secondary finding
       Other findings that either talk about secondary variables, or other confounds in the data
4. Discussion
    a. What did they answer?
    b. Any other unanswered questions?
    c. Future work:
       Resolving confounds, or other ways to test the same hypothesis.

b) and c) may not always be there in the paper! Think critically about these once you understand the paper.

Take notes as you go

- Literature Review Table
- Literature Review Outline
- Paper Notes (organization helps)
- Casual Notes (subsequent organization)

Take notes as you go

- Literature Review Table
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Child Development, July/August 1999, Volume 70, Number 4, Pages 1005–1016

Cultural Differences in Maternal Beliefs and Behaviors: A Study of Middle-Class Anglo and Puerto Rican Mother-Infant Pairs in Four Everyday Situations

Robin L. Harwood, Axel Schoelmerich, Pamela A. Schulze, and Zenaida Gonzalez

This study examines cultural patterning in situational variability in mother-infant interactions among middle-class Anglo and Puerto Rican mothers and their 12 to 15-month-old firstborn children. Forty mothers were interviewed regarding their long-term socialization goals and childrearing strategies, and videotaped interacting with their infants in four everyday settings: feeding, social play, teaching, and free play. Results suggest that: (1) Anglo mothers place greater emphasis on socialization goals and childrearing strategies consonant with a more individualistic orientation, whereas Puerto Rican mothers place greater focus on goals and strategies consistent with a more sociocentric orientation; (2) coherence was found between mothers' childrearing beliefs and practices, with Puerto Rican mothers more likely to directly structure their infants' behaviors; and (3) situational variability arose in mother-infant interactions, but this variability showed a cultural patterning consistent with mothers' long-term socialization goals and childrearing beliefs.

INTRODUCTION

The past decade has brought increased interest among researchers in understanding the cultural context of childhood. Along with this concern has come a heightened consideration of appropriate theoretical frameworks for the study of culture and child development. In particular, interpretive approaches have been articulated among several researchers (Cole, 1996; Harkness & Super, 1996; Shweder, 1996). Despite their diversity, interpretive approaches generally share the assumption that human beings construct meaning through their cultural symbol systems, with language being one of culture's most powerful symbol systems. Many of these approaches go on to assert that this construction occurs within a matrix of social interaction, in which the child as participant actively produces and reproduces culturally meaningful patterns of beliefs and behaviors (e.g., Corsaro & Miller, 1992; Goodnow, Miller, & Kessel, 1995; Rogoff, Mistry, Goncu, & Mosier, 1993; Schieffelin & Ochs, 1986).

As interpretive approaches become more widely used and recognized, certain themes appear to recur and to demand continued refinement. One salient question involves the use of terms like "individualistic/independent" or "collectivistic/interdependent" as heuristic devices to characterize broad-level cultural belief systems and practices (cf. Greenfield & Cocking, 1994; Markus & Kitayama,1991; Shweder & Bourne, 1984; Triandis, Bontempo, Villareal, Asai, & Lucca, 1988). Briefly, American culture is often described as "individualistic" in that it conceives of the individual as an "independent, self-contained, autonomous entity who (a) comprises a unique configuration of internal attributes . . . and (b) behaves primarily as a consequence of those internal attributes" (Markus & Kitayama, 1991, p. 224; see also Kessen, 1979; Sampson, 1989; Shweder & Bourne, 1984; Spence, 1985). This construal of the self is described as a key component of the beliefs and practices which organize perceptions of and interactions with children in America, thus constituting a primary aspect of the cultural context of childhood in this country (Harkness & Super, 1996; Harwood, Miller, & Lucca Irizarry, 1995; Rogoff et al., 1993; Schieffelin & Ochs, 1986).

In contrast, many other cultures are described as "sociocentric" or "interdependent" in that they emphasize the fundamental connectedness of human beings to one another: "Experiencing interdependence entails seeing oneself as part of an encompassing social relationship and recognizing that one's behavior is determined, contingent on, and, to a large extent organized by what the actor perceives to be the thoughts, feelings, and actions of *others* in the relationship" (Markus & Kitayama, 1991, p. 227). Again, this emphasis on interdependence is depicted by many researchers as a key component of the beliefs and practices that organize perceptions of and interactions with children in a variety of non-Western cultures, thus constituting a primary aspect of the cultural context of childhood in these countries (cf. Greenfield & Cocking, 1994; Kurtz, 1992; Tobin, Wu, & Davidson, 1989; Triandis, Marin, Lisansky, & Betancourt, 1984).

Critics of this approach have maintained that such global characterizations are unidimensional and do

Literature Review Table

	A	B	C	D	E
1	**first author ... last author (year)**	**title**	**sample**	**independent variable(s)**	**dependent variable(s)**
2	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.	Anglo & Puerto Rican (PR) dyads (n=40 | PR=18, A=22); Middle class; Infants age: 12-15mo	Maternal parenting Verbal and Non-verbal behaviors	Child Self-Maximization, Self-Control, Proper Demeanor, Decency
3	**other relevant variables**	**study design/procedures**	**main results**	**secondary results**	**comment**
4	na	Mothers were interviewed about their long-term socialization goals and childrearing strategies; 4 everyday dyad interactions were videotaped (social play, feeding, teaching, and free play) 1) Feeding. 10mins 2) Social Play. 5mins 3) Teaching. 3mins 4) Free Play. 8mins 2 interview sessions were in homes with ethnically matched interviewers - 1st session video recording of 4 everyday interactions - 2nd interview of mother (goals and beliefs) *Videos done prior to avoid biasing interaction of dyads led by mom	(1)Anglo mothers place greater emphasis on socialization goals and childrearing strategies consonant with a more individualistic orientation PR mothers place greater focus on socialization goals and childrearing strategies w/ a more sociocentric orientation (2) there was coherence in childrearing beliefs and practices, but PR mothers more likely to directly structure their infants' behaviors (3) mother-infant interactions displayed situational variability but this variability showed cultural patterning consistent with mothers long-term socialization goals and childrearing beliefs	na	Video Coding: Videos were coded using the software program Interact. Coding accounted for:

Child Development, July/August 1999, Volume 70, Number 4, Pages 1005–1016

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UCTION

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Literature Review Outline

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.

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Child Development, July/August 1999, Volume 70, Number 4, Pages 1005–1016

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Literature Review Outline

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

METHODS
Participants
-Anglo & Puerto Rican (PR) dyads (n=40 | PR=18, A=22)
Middle class
Infants age: 12-15mo

Study Design:
-Mothers were interviewed about their long-term socialization goals and childrearing strategies
-4 everyday dyad interactions were videotaped (social play, feeding, teaching, and free play)

→ 2 interview sessions were in homes with ethnically matched interviewers
- 1st session video recording of 4 everyday interactions
- 2nd interview of mother (goals and beliefs)
*Videos done prior to avoid biasing interaction of dyads led by mom

Mother-Infant Interactions:
1) *Feeding.* 10mins
2) *Social Play.* 5mins
3) *Teaching.* 3mins
4) *Free Play.* 8mins

Video Coding:
Videos were coded using the software program *Interact.*
Coding accounted for:
1 – frequency of behaviors (M verbal, M non-verbal and infant)
2 – frequency of behaviors and duration of settings specific of each situation

Maternal Verbal (measured frequency)
1- signals infant's attention by calling infant's name
2- praises infant
3- offers infant affection by using term of endearment
4- directly structures infant behavior tells infant to perform or not perform an action
5- indirectly structures infant behavior suggests infant perform or not perform an action

Maternal Non-verbal (measured frequency)
1- attempts to signal infant's attention by tapping or pointing
2- praises infant by clapping and cheering
3- positions infant
4- restrains infant when infant attempts to pull away or wander off
5- offers affection by hugging/kissing infant.

Infant Non-verbal Behavior
1- resists maternal intervention, displaying negative affect
2- disengages from direct physical contact with the mother without signs of negative affect
3- wanders away by retreating out of arm's length of mother

Additional Coding:
- feeding: autonomy vs spoon-feeding
- social play: duration of 4 types of dyadic games
- teaching: duration infants spend on-task AND duration mothers attempt to teach
- free play: duration of dyad play, of infant alone w/ mom watching, mom attempts to **shift attention** to a new toy when infant is w/ another toy, mother attempts to gain infant attention when infant is not playing, AND no play at all

Coding Categories
(a) Self-Maximization
(b) Self-control
(c) Lovingness
(d) Decency
(e) Proper Demeanor

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Cultural Differences in Maternal Beliefs and Behaviors: A Study of Middle-Class Anglo and Puerto Rican Mother-Infant Pairs in Four Everyday Situations

RESULTS
(1)Anglo mothers place greater emphasis on socialization goals and childrearing strategies consonant with a more **individualistic orientation**

PR mothers place greater focus on socialization goals and childrearing strategies w/ a more **sociocentric orientation**

(2) there was coherence in childrearing beliefs and practices, but PR mothers more likely to **directly structure** their infants' **behaviors**

(3) mother-infant interactions displayed **situational variability** but this variability showed **cultural patterning consistent with mothers long-term socialization goals and childrearing beliefs**

Paper Notes

Child Development, July/August 1999, Volume 70, Number 4, Pages 1005–1016

Cultural Differences in Maternal Beliefs and Behaviors: A Study of Middle-Class Anglo and Puerto Rican Mother-Infant Pairs in Four Everyday Situations

Robin L. Harwood, Axel Schoelmerich, Pamela A. Schulze, and Zenaida Gonzalez

This study examines cultural patterning in situational variability in mother-infant interactions among middle-class Anglo and Puerto Rican mothers and their 12 to 15-month-old firstborn children. Forty mothers were interviewed regarding their long-term socialization goals and childrearing strategies, and videotaped interacting with their infants in four everyday settings: feeding, social play, teaching, and free play. Results suggest that: (1) Anglo mothers place greater emphasis on socialization goals and childrearing strategies consonant with a more individualistic orientation, whereas Puerto Rican mothers place greater focus on goals and strategies consistent with a more sociocentric orientation; (2) coherence was found between mothers' childrearing beliefs and practices, with Puerto Rican mothers more likely to directly structure their infants' behaviors; and (3) situational variability arose in mother-infant interactions, but this variability showed a cultural patterning consistent with mothers' long-term socialization goals and childrearing beliefs.

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As interpretive approaches become more widely used and recognized, certain themes appear to recur and to demand continued refinement. One salient question involves the use of terms like "individualistic/independent" or "collectivistic/interdependent" as heuristic devices to characterize broad-level cultural belief systems and practices (cf. Greenfield & Cocking, 1994; Markus & Kitayama,1991; Shweder & Bourne, 1984; Triandis, Bontempo, Villareal, Asai, & Lucca, 1988). Briefly, American culture is often described as "individualistic" in that it conceives of the individual as an "independent, self-contained, autonomous entity who (a) comprises a unique configuration of internal attributes . . . and (b) behaves primarily as a consequence of those internal attributes" (Markus & Kitayama, 1991, p. 224; see also Kessen, 1979; Sampson, 1989; Shweder & Bourne, 1984; Spence, 1985). This construal of the self is described as a key component of the beliefs and practices which organize perceptions of and interactions with children in America, thus constituting a primary aspect of the cultural context of childhood in this country (Harkness & Super, 1996; Harwood, Miller, & Lucca Irizarry, 1995; Rogoff et al., 1993; Schieffelin & Ochs, 1986).

In contrast, many other cultures are described as "sociocentric" or "interdependent" in that they emphasize the fundamental connectedness of human beings to one another: "Experiencing interdependence entails seeing oneself as part of an encompassing social relationship and recognizing that one's behavior is determined, contingent on, and, to a large extent organized by what the actor perceives to be the thoughts, feelings, and actions of *others* in the relationship" (Markus & Kitayama, 1991, p. 227). Again, this emphasis on interdependence is depicted by many researchers as a key component of the beliefs and practices that organize perceptions of and interactions with children in a variety of non-Western cultures, thus constituting a primary aspect of the cultural context of childhood in these countries (cf. Greenfield & Cocking, 1994; Kurtz, 1992; Tobin, Wu, & Davidson, 1989; Triandis, Marin, Lisansky, & Betancourt, 1984).

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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 of 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.

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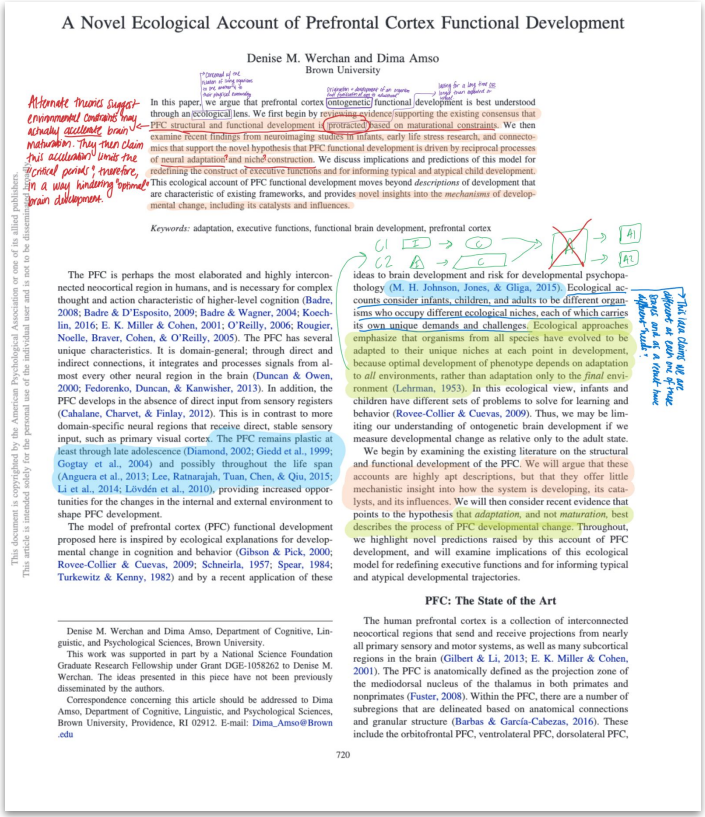

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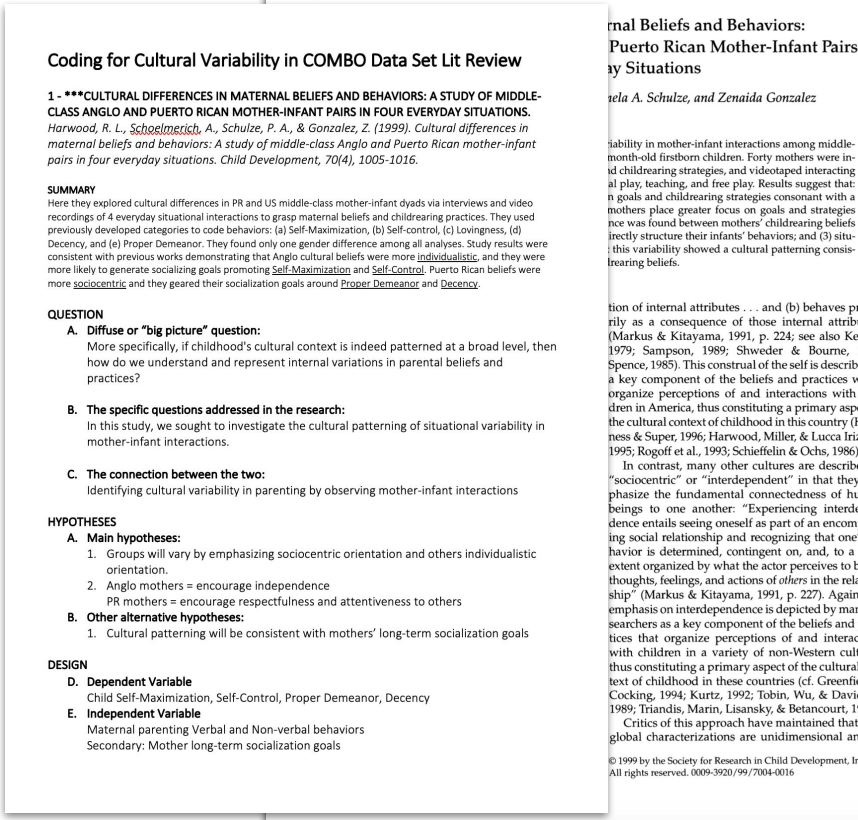

Coding for Cultural Variability in COMBO Data Set Lit Review

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

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Walk through

Choose one…

- Literature Review Table
- Literature Review Outline
- Paper Notes (organization helps)
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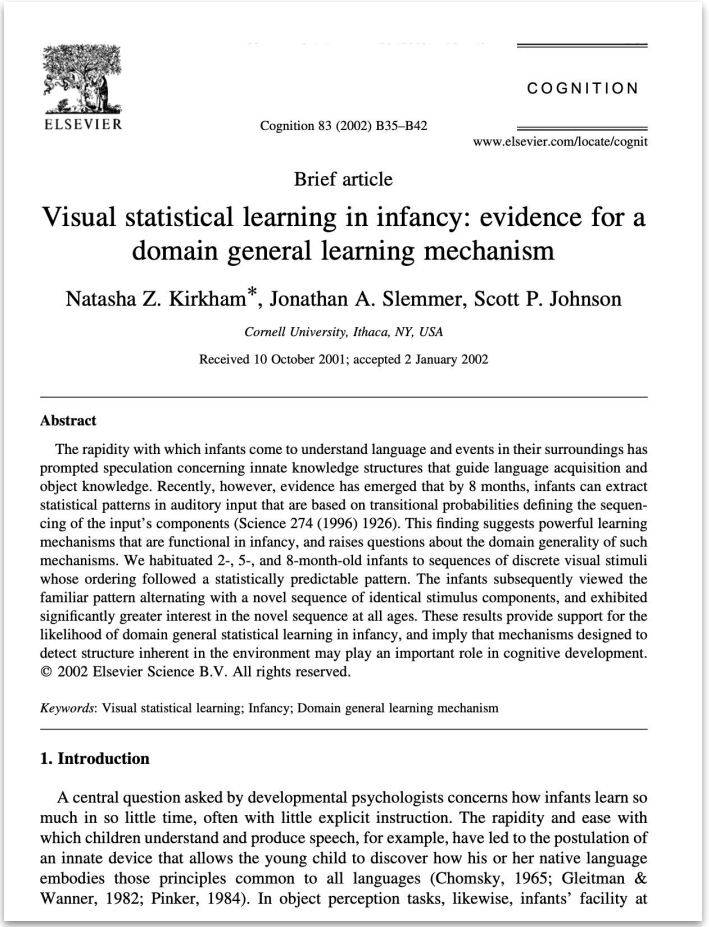

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COGNITION

Cognition 83 (2002) B35–B42

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Brief article

Visual statistical learning in infancy: evidence for a domain general learning mechanism

Natasha Z. Kirkham*, Jonathan A. Slemmer, Scott P. Johnson

Cornell University, Ithaca, NY, USA

Received 10 October 2001; accepted 2 January 2002

Abstract

The rapidity with which infants come to understand language and events in their surroundings has prompted speculation concerning innate knowledge structures that guide language acquisition and object knowledge. Recently, however, evidence has emerged that by 8 months, infants can extract statistical patterns in auditory input that are based on transitional probabilities defining the sequencing of the input's components (Science 274 (1996) 1926). This finding suggests powerful learning mechanisms that are functional in infancy, and raises questions about the domain generality of such mechanisms. We habituated 2-, 5-, and 8-month-old infants to sequences of discrete visual stimuli whose ordering followed a statistically predictable pattern. The infants subsequently viewed the familiar pattern alternating with a novel sequence of identical stimulus components, and exhibited significantly greater interest in the novel sequence at all ages. These results provide support for the likelihood of domain general statistical learning in infancy, and imply that mechanisms designed to detect structure inherent in the environment may play an important role in cognitive development.

Keywords: Visual statistical learning; Infancy; Domain general learning mechanism

1. Introduction

A central question asked by developmental psychologists concerns how infants learn so much in so little time, often with little explicit instruction. The rapidity and ease with which children understand and produce speech, for example, have led to the postulation of an innate device that allows the young child to discover how his or her native language embodies those principles common to all languages (Chomsky, 1965; Gleitman & Wanner, 1982; Pinker, 1984). In object perception tasks, likewise, infants' facility at

First: Question

- What are questions are being asked/addressed? (aka: what is the goal of this paper?)

  → Look at the last paragraph of the introduction

  The last paragraph usually reinstates the question at hand and/or the hypotheses.

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The present study had two goals. First, we probed the question of domain generality of statistical learning in infancy by asking whether it is limited to auditory information. This was accomplished with a task in which infants were presented with sequential visual input that contained probabilistic structure. Second, we tested infants younger than those observed by Saffran et al. (1996, 1999), to probe the developmental time-course of statistical learning during the first year after birth. We used a visual habituation procedure, an effective tool for investigating perceptual and cognitive processes in infants as young as neonates (Slater, 1995).

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First: Question(s)/Hypotheses

I. Question

A. Diffuse, or “big picture” question: it is unknown at present if young infants can detect statistically defined structure in sequential visual stimuli.

B. The specific question(s) addressed in the research:

1. question of domain generality of statistical learning in infancy by asking whether it is limited to auditory info
2. probed the developmental time-course of statistical learning during the first year after birth.

II. Alternative Hypotheses

A. Main hypothesis:

B. Other alternatives:

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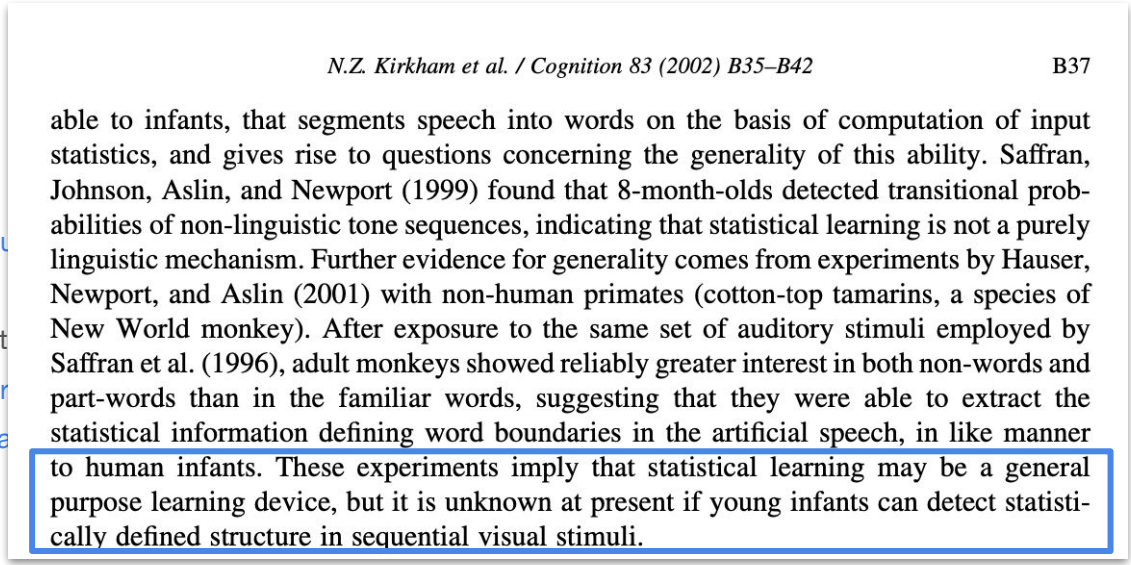

N.Z. Kirkham et al. / Cognition 83 (2002) B35–B42 B37

able to infants, that segments speech into words on the basis of computation of input statistics, and gives rise to questions concerning the generality of this ability. Saffran, Johnson, Aslin, and Newport (1999) found that 8-month-olds detected transitional probabilities of non-linguistic tone sequences, indicating that statistical learning is not a purely linguistic mechanism. Further evidence for generality comes from experiments by Hauser, Newport, and Aslin (2001) with non-human primates (cotton-top tamarins, a species of New World monkey). After exposure to the same set of auditory stimuli employed by Saffran et al. (1996), adult monkeys showed reliably greater interest in both non-words and part-words than in the familiar words, suggesting that they were able to extract the statistical information defining word boundaries in the artificial speech, in like manner to human infants. These experiments imply that statistical learning may be a general purpose learning device, but it is unknown at present if young infants can detect statistically defined structure in sequential visual stimuli.

II. Alternative Hypotheses

A. Main hypothesis: Statistical learning may be a general purpose learning device; hence it should also apply visually

B. Other alternatives: This learning mechanism may be available to infants at younger ages than those tested to date.

Second: Deep Dive Into Methods & Study Design

→ Look at the methods section

Methods sections are usually thorough and straight to the point. This means it is (1) easier to digest and (2) will really inform the reader in a step-by-step manner what was done.

- **Study Design**

  A. What are my variables of interest?

  - Dependent variables (DV)
  - Independent variables (IV)

- **Methods**

  A. Realization of each independent and dependent variable:

  1. Participants
  2. Stimuli/questionnaires/assessments

  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:

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2. Method

2.1. Participants

Forty-eight full-term infants (22 females) composed the final sample, 16 2-month-olds (M age = 64.9 days, SD 7.4), 16 5-month-olds (M age = 151.6 days, SD 8.3), and 16 8-month-olds (M age = 240.9 days, SD 15.9). Nine additional infants were observed but not included in the analyses due to fussiness ($n = 5$), sleepiness ($n = 2$), or equipment failure ($n = 2$). The infants were recruited by letter and telephone from hospital records and birth announcements in the local newspaper. Parents and infants received a small gift (a baby t-shirt or toy) for their participation.

2.2. Apparatus and stimuli

A Macintosh G4 computer and 53 cm color monitor were used to present stimuli and collect looking time data. An observer viewed the infant on a second monitor and entered looking judgments with a keypress on the computer keyboard. The observer was unaware of the stimulus sequence viewed by the infant. The computer presented displays, recorded looking times, calculated the habituation criterion for each infant, and changed displays after the criterion was met. Stimuli consisted of six colored shapes (turquoise square, blue cross, yellow circle, pink diamond, green triangle, and red octagon) presented one at a time in a continuous stream, with no break or delay between shapes. Each shape was presented for 1 s and loomed from 4 to 24 cm in height (2.4–14.6°). (Pilot testing revealed that

Second: Deep Dive Into Methods

→ Look at the methods section

- **Study Design**

  A. What are my variables of interest?
  - Dependent variables (DV)
  - Independent variables (IV)

- **Methods**

  A. Realization of each independent and dependent variable:
  1. Participants
  2. Stimuli/questionnaires/assessments

  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:

2. Method

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looming was effective for maintaining infants' attention throughout the experiment.) The stream of stimuli was shown as long as the infant attended to the monitor. A trial ended when the infant looked away for 2 s, or had looked for 60 s (the maximum trial duration was lengthened to 90 s for the 2-month-olds). Between trials, a beeping target was shown to attract attention back to the screen.

2.3. Procedure

Infants were tested individually and sat on a parent's lap 95 cm from the computer monitor. The parent was instructed not to interact with the infant or watch the monitor. The stimuli appeared in a continuous stream of randomly-ordered pairs (e.g. pair 1: turquoise square followed by blue cross; pair 2: yellow circle followed by pink diamond; pair 3: green triangle followed by red octagon; see Fig. 1), with only transitional probabilities defining between-stimulus boundaries (the transitional probability within pairs was 1.0 and between pairs it was 0.33). Shape pairing was randomized by the computer for each infant. The initial member of a shape pair always predicted the next member, and the next stimulus after a pair was constrained to be the initial member of one of the three allowable pairs. For an individual infant, the pairs were always the same, but the order of the pairs within the sequence was random. The infants were habituated to this sequence until habituation of looking occurred or 12 trials had elapsed. The habituation criterion was defined as a decline in looking times across a block of four trials adding up to less than 50% of looking times during the first four trials. After habituation, infants viewed six test displays alternating between familiar sequences, composed of the same three pairs of shapes, and novel sequences, produced by randomly ordering the same shapes. In the novel sequences, the single constraint on stimulus order was that there were never two identical stimuli in a row. The only difference between familiar and novel sequences was the transitional probabilities between the shapes. This ensured that any looking time difference observed would necessarily be related to the statistical structure of the

Second: Deep Dive Into Methods

→ Look at the methods section

- **Study Design**

  A. What are my variables of interest?

  - Dependent variables (DV): Looking time (visual statistical learning)
  - Independent variables (IV): Familiar & novel sequences, Infant age

Second: Deep Dive Into Methods

- **Methods**

  A. Realization of each independent and dependent variable:

  1. Participants: N=48 | F=22, M=26

  2. Stimuli/questionnaires/assessments:

  Assessments: Computer assessment testing visual statistical analyses

  Stimuli: Different color shapes: (turquoise square, blue cross, yellow circle, pink diamond, green triangle, and red octagon)

  B. Procedure:

  1. Instructions: Infants sat on a parent's lap facing the computer monitor; parent was told not to interact w/ infant or watch monitor.

  2. What they see, when, for how long, and in what order: The stimuli appeared in a continuous stream of randomly-ordered pairs (e.g. pair 1: turquoise square followed by blue cross; pair 2: yellow circle followed by pink diamond; pair 3: green triangle followed by red octagon); shapes were shown for 1s.

  3. Data Collection: Presented displays, recorded looking times, calculated the habituation criterion for each infant, & changed displays

  4. Length of entire experimental procedure: Trials ended when the infant looked away for 2s, or had looked for 60s (the max duration was lengthened to 90 s for the 2-month-olds).

Third: Results

a) Main finding:

-> I like to first look at the graph. A well-written paper will have a self-explanatory results figure! (at least the newer ones do)

From Fig 2, I see that:

- *The x-axis has age groups: 2, 5, and 8 months*
- *The y-axis has mean looking time in seconds!*
- *I see that there are two types of bars - familiar vs. novel for each age group*
- *And for each age group, I see that the novel bars are higher than the familiar bars.*

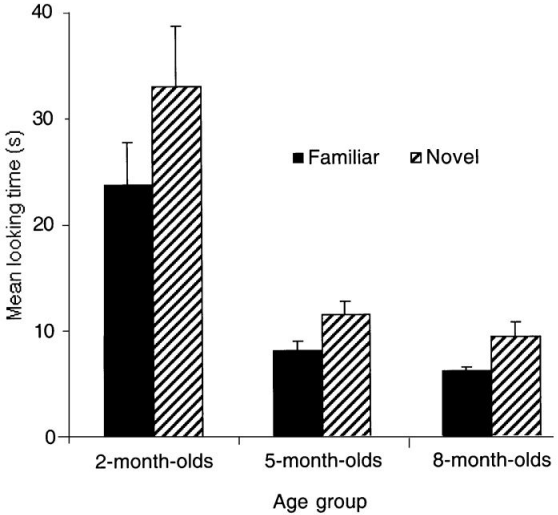

Fig. 2. Looking times after habituation. Infants at all three ages looked reliably longer at the novel sequence, relative to the familiar sequence.

Infants looked longer at the Novel sequence compared to the Familiar sequence.

Third: Results

a) Main finding:

Was this finding statistically significant? How much sense can be make out of this finding?

-> I look at the results section and try to find the statistical values from that.

So it seems like, this finding was statistically significant for the 2-, 5-, and 8-month olds

3. Results

Infants in all three age groups exhibited longer looking at the novel sequence, relative to the familiar sequence, after habituation (see Fig. 2). Twelve of the 16 2-month-olds showed this preference (Wilcoxon matched pairs test, $z = 2.38$, $P < 0.05$), as did 11 of the 16 5-month-olds ($z = 2.33$, $P < 0.05$) and 12 of the 16 8-month-olds ($z = 2.02$, $P < 0.05$). (The Wilcoxon statistic takes account of the magnitude of differences in performance, and is therefore a more sensitive test of infants' preferences than, say, a sign test.) These conclusions were confirmed with parametric analyses. Looking time data in some cells were positively skewed (which is often the case in visual habituation procedures with young infants), and all data were therefore log-transformed prior to analysis; data shown in Fig. 2 are based on raw scores. A 2 (sex: male vs. female) × 3 (age: 2, 5, or 8 months) × 2 (order: familiar vs. novel sequence seen first after habituation) × 2 (test display: familiar vs. novel sequence) mixed ANOVA yielded a significant main effect of age ($F(2, 36) = 21.10$, $P < 0.001$), the result of longer looking overall by the youngest infants. (Very young infants typically exhibit longer looking times than older infants in visual tasks, which may reflect developmental differences in infants' basic information processing skills (see Johnson, 1996).) There was also a significant main effect of test display ($F(1, 36) = 14.67$, $P < 0.001$), the result of longer looking overall at the novel sequence. There were no other significant main effects or interactions. Planned comparisons (simple effects tests) revealed a reliable preference for the novel sequence in each age group (2-month-olds, $F(1, 36) = 4.30$, $P < 0.05$; 5-month-olds, $F(1, 36) = 7.00$, $P < 0.05$; 8-month-olds, $F(1, 36) = 4.15$, $P < 0.05$). (Simple effects tests take into account the omnibus error term of the ANOVA, and are the functional equivalent of a series of more conservative t-tests to examine preferences in each age group.)

Infants across all age groups looked longer at the Novel sequence compared to the Familiar sequence.

Third: Results

b) Secondary findings

-> What else did they find in this study? Let's look at the rest of the results section.

It seems like:
There is an effect such that the 5-month olds look at the sequences the longest (regardless of whether the sequence is novel or not)

And we could see that in the figure as well!

3. Results

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Takeaways (usually from the Discussion)

a) What did they answer?

-> Go back to the specific questions/hypothesis:

1. *question of domain generality of statistical learning in infancy by asking whether it is limited to auditory info*
2. *probed the developmental time-course of statistical learning during the first year after birth.*

-> Looking at the discussion (and based on the results)

1. *Yes, domain generality in statistical learning of visual stimuli in infancy*
2. *Seems to be there very early in infancy, and so they theorize that it is dependent on visual experience. (it seems reasonable to posit …..)*

These results are consistent with the existence of a domain general statistical learning device that is available to even very young infants (indeed, we found no evidence that the older infants were better able to compute the statistical structure in the input than the youngest infants we tested). Given the youngest age tested in addition to the lack of observed development, it seems reasonable to posit an associative mechanism that is functional with the onset of visual experience. This statistical learning mechanism is powerful enough to ascertain visual input structure after only a few minutes of exposure in a highly constrained, unnatural setting. Moreover, it appears to operate outside other potential contributions to learning in infancy, such as reinforcement, that would normally supplement patterns of input in the environment. In everyday situations, infants would presumably benefit from other kinds of structure in the course of cognitive development, such as intermodal information (e.g. the consistent pairing of certain sights and sounds), as well as direct instruction and other social interactions.

Takeaways (usually from the Discussion)

b) Unanswered questions:
c) Future work:

-> This can sometimes be found in the discussion but there might be other times when you can come up with these.

- How did infants do statistical learning?
  - Did they learn it implicitly or explicitly?
  - Can we even test that in 2-month olds?

-> These are things I found from the discussion, but maybe if I was more familiar with this research, I could come up with other confounds, or unanswered questions.

At present we have no information concerning how the infants computed the statistics of the stimulus sequences. Mechanisms to accomplish such computations may be rather primitive, and can be instantiated in simple recurrent networks (e.g. Cleeremans & McClelland, 1991). However, not all sequence learning can be construed as primitive. Studies of implicit learning in adults, for example, reveal the existence of mechanisms that detect input structure of complex sequences known as artificial grammars, as indicated by accelerated response times upon repeated exposure (Reber, 1989). In these tasks, learners are often unable to report the rules underlying the sequence. Nevertheless, adults are remarkably facile at such tasks (see Stadler & Frensch, 1998 for review), and evidence is beginning to emerge that children also can learn intricate stimulus sequences without explicit knowledge of the statistical structure of the input (Meulemans, Van der Linden, & Perruchet, 1998), and even without attending to the stimuli (Saffran, Newport, Aslin, Tunick, & Barrueco, 1997). Moreover, 12-month-old infants have been found to generalize their knowledge of complex patterns in artificial grammars (Gomez & Gerken, 1999; cf. Marcus, Vijayan, Bandi Rao, & Vishton, 1999). We do not know whether the infants we observed learned the sequences implicitly or explicitly, or even if such distinctions are applicable to such a young population. In spite of these remaining questions, documentation of statistical learning in young infants contributes an important piece of information to our knowledge base concerning human learning, in addition to implicit and rule learning in children and adults.

Obviously, statistical learning is unlikely to account for all aspects of cognitive development in humans. There are constraints on what can be learned, and who can learn it: only humans show the full range of language acquisition and production skills, for example, despite some cross-species commonalities in mechanisms for word segmentation (Hauser et al., 2001). Nevertheless, our findings, in conjunction with those of Gomez and Gerken (1999) and Saffran et al., 1996, Saffran et al., 1999, are consistent with the thesis that early development is highly attuned to the multifaceted structure of the infant's environment, and suggest that learning the statistical regularities of the environment may be a critical part of the cognitive apparatus with which infants make sense of the world.

Let’s breakdown another paper together!

Try going through the other paper (Godden & Baddeley, 1975) and use one of our suggested methods for taking notes.