Available online at www.sciencedirect.com

ScienceDirect

Current Opinion in Behavioral Sciences

The origins of *same/different* discrimination in human infants

Susan Hespos, Dedre Gentner, Erin Anderson and Apoorva Shivaram

The ability to detect relational patterns shared by different objects, events, or ideas is a cornerstone of our higher reasoning ability. This characteristic of humans' abilities may have its origins in a relational processing mechanism that allows us to abstract *same/different* representations using comparison. This article discusses research that investigates the nature of this ability and how it develops by exploring relational learning in infants and tracing its development over the first year of life. Delineating the conditions that promote relational learning in young infants allows for comparisons to relational learning in children and adults. More broadly, this research influences our understanding of human cognition and how it differs from that of other species.

Address
Psychology Department, Northwestern University, United States

Corresponding author: Hespos, Susan (hespos@northwestern.edu)

Current Opinion in Behavioral Sciences 2020, **37**:69–74

This review comes from a themed issue on **Same-different conceptualization**

Edited by **Edward A Wasserman**, **Jean-Rémy Hochmann** and **Susan Carey**

https://doi.org/10.1016/j.cobeha.2020.10.013

Introduction

Human cognition is striking in its brilliance and adaptability. We readily generalize across situations and form abstractions that can inform future reasoning. A number of theorists have argued that the key to our higher-order cognition is our exceptional talent for relational representation and reasoning [1–5]. Accounts of relational reasoning generally agree that relational ability in human adults is characterized by both rich relational representations and powerful relational processes [6]. How does relational cognition in humans begin?

This article reviews the origins of our uniquely powerful relational ability. Do humans begin life endowed with extraordinary relational learning ability, which then enables us to learn a repertoire of relational representations? And/or are some early relations privileged — either part of our initial endowment, or prepotent in learning [7–10]. We can distinguish three broad positions. The strongest possibility is that human infants are born not only with analogical ability but also with a set of abstract relations that they naturally use to encode experience even very early in learning. Such a set would almost certainly include the *same-different* relation. A second possibility is that human infants are born with analogical processing ability, with which they can learn relations from experience, but without a starting set of primitive relations. A third possibility is that analogical ability is not inherent in human biology, but instead develops through combining other abilities and experiences.

The value of this inquiry is in allowing us to discover the roots of relational cognition. Adults' ability to use abstract categories and rules is supported by a vast store of conceptual knowledge, influenced by the culture that surrounds us and the languages we speak, as well as by real world experience. To gain an understanding of the nature and origin of our extraordinary relational ability, we must investigate infants who have not had much exposure to language and culture. If we can specify how infants develop relational abstractions, then we will be in a better position to understand how language and culture capitalize on these existing cognitive abilities.

Evidence concerning *same-different* processing in human infants

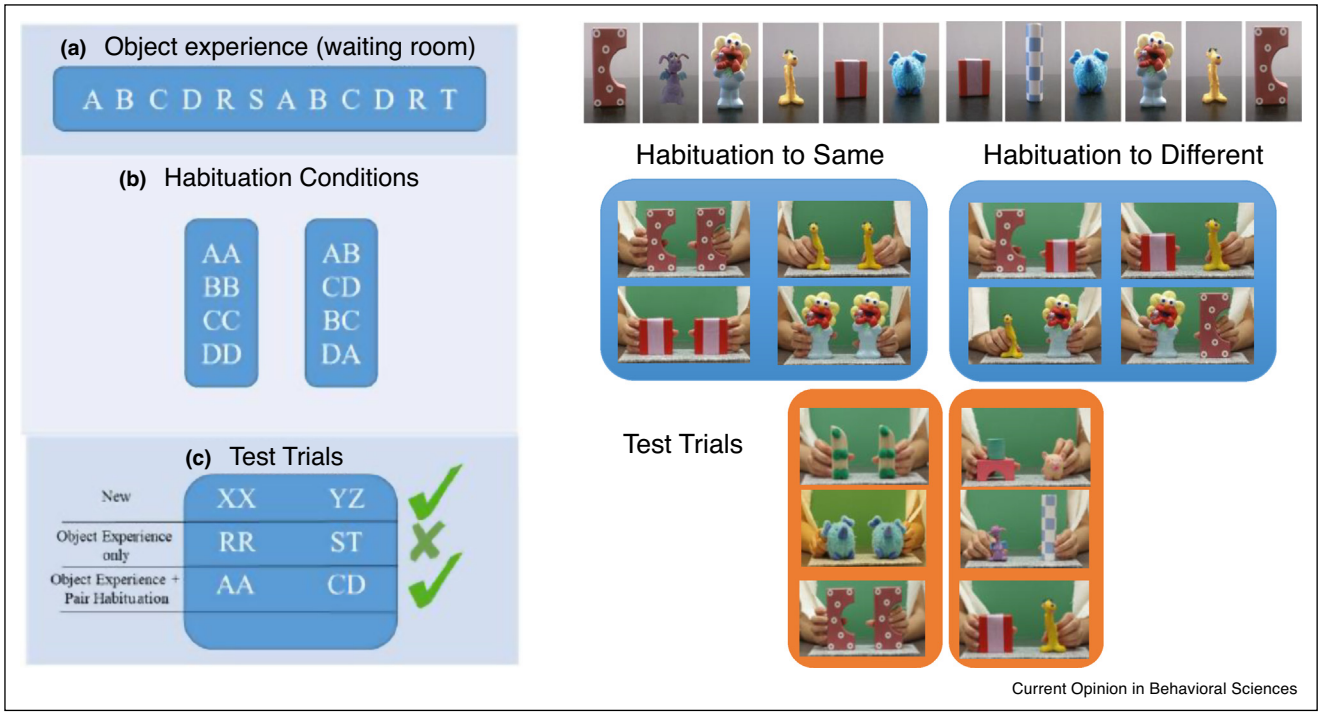
Because of the centrality of *same-different* relations in cognition and in cross-species comparisons, a key question is whether and when infants acquire insight into these relations. More specifically, can infants distinguish *same* pairs from *different* pairs, and if so, how? The first possibility that *same* and *different* are part of a core set of inborn or prepotent relations has been widely assumed, based on a highly cited study by Tyrrell *et al.* [11•], using a preferential looking paradigm. They reported that 7-month-old infants encode abstract *same* and *different* relations without training, simply from exposure to a single exemplar. However, the reported results collapsed across the generalization test trial (Given AA, did infants look longer at XX than at YZ) and the identical-item test trial (Given AA, did infants look longer at BC than at AA). Thus we cannot conclude that the infants had abstracted the relation. We therefore replicated Tyrrell *et al.*'s

methods with the same age group [12•] and looked at the generalization trials separate from the recall trials. Our collapsed results looked the same as Tyrrell *et al.*'s [11•]. However, when we separated the generalization trials from the recall trials, it revealed that the effect was due to the recall of the identical exemplar alone. In other words, infants showed a novelty response when comparing the identical pair they had seen (e.g. AA) with a new pair (BC); but when the familiarized relation and the competing relation were tested with new objects (e.g. XX versus YZ), the infants showed no preference. In short, we found no evidence that infants encode abstract *same* and *different* relations without training. This finding runs counter to the notion that infants are born with a set of abstract relations.

Next, we tested the second position: whether infants are capable of learning an abstract relation by structural alignment. According to structure-mapping theory [13•], comparing at least two exemplars supports aligning and highlighting their common structure, and a series of comparisons can lead to gradual abstraction of the common structure across exemplars [2,14,15•]. We showed infants a sequence of four exemplars of *same* or *different* toys [see Figure 1]. We used a habituation/dishabituation paradigm, and the pairs were made of perceptually rich toys (e.g. Elmos, blocks, *etc.*). Half the infants saw *same* pairs (e.g. AA, BB, CC, DD) and half saw *different* pairs (AB, CD, BC, DA) that were repeated until infant looking declined sufficiently to demonstrate habituation (about 6–9 trials). We then showed infants a sequence of six test trials. On alternating trials, infants saw pairs of objects that were either the *same* or *different*. The dependent measure was the duration of infants' looking times. The key question was whether infants who had seen multiple exemplars of one relation would look longer at the novel relation when instantiated with new objects (XX versus YZ). We found infants were able learn and generalize the relation. Infants habituated to *same* or *different* pairs were able to detect the novel relations with new objects.

The ability to abstract and transfer a relation from a series of examples is one signature of analogical learning in older children and adults [15•]. We also tested a second signature of relational learning — whether object salience would interfere with structural alignment. Before the experiment, we gave infants a brief exposure to a subset of the objects used in test trials, thus increasing the salience of these individual objects. We found that infants failed to discriminate between the *same* and *different* relations when the test pairs contained objects that had

Figure 1



Schematic of events in Ferry *et al*. [12•] Experiment 2. Left side: **(a)** In the waiting room, infants saw a subset of the individual toys before the experiment. **(b)** Infants were habituated to four pairs of objects, either *same* or *different*. **(c)** In six sequential test trials, looking time was recorded to the novel and familiar relational pairs in three different types of test trials. Green check marks indicate conditions where there was significantly longer looking at the novel compared to the familiar relation. Green X indicates test conditions where, as predicted, infants failed to discriminate between the novel and familiar relations. Right side: Photos of the specific objects used in each trial.

been rendered individually salient before habituation — consistent with the findings among older children, for whom object salience interferes with analogical comparison [16,17]. These findings suggest that by 7 months, infants show the basic characteristics of analogical learning — their learning was facilitated by comparison across examples and hindered by object focus. We interpret these findings as showing that the analogical processing ability is present in the first year of life and may be continuous through development.

We argue that the critical difference between the Tyrrell *et al.*'s experiment, where infants failed to generalize *same* and *different*, and Ferry *et al.*'s experiment, where infants succeeded, was that Ferry *et al.* presented infants with multiple exemplars. However, these designs also differed in that the latter used a habituation/dishabituation paradigm. Consequently in a recent experiment, we habituated 7-month-old and 9-month-old infants to a single exemplar. As before, they did not generalize the *same-different* relation when they received only one exemplar [18], providing further evidence that infants are abstracting the *same-different* relations, which requires alignment and comparison across exemplars.[1]

Revisiting the three broad positions about the origins of our relational abilities, our non-replication of the Tyrrell *et al.* [11•] one-exemplar study runs counter to the idea that *same-different* is part of a pre-existing set of core relations. Our finding that 7-month-old and 9-month-old infants can distinguish *same* and *different* after experiencing a series of comparable exemplars, argues against the third position we considered: that analogical ability arises late, through experiences and combining other capacities such as language. Some converging evidence for the second position comes from studies examining repetition in linguistic structures. Here, as in our studies, 6-month-old to 12-month-old infants can generalize these structures after being presented with multiple exemplars [20–23]. Although language and conceptual learning clearly refine and extend our analogical abilities, our findings indicate that these abilities are present before extensive cultural and linguistic experience. In sum, while our studies do not rule out the possibility of innate *same* and *different* relations [16] they provide the most support for the second position: that infants have a relational processing mechanism that allows them to compare across examples to form abstract relations.

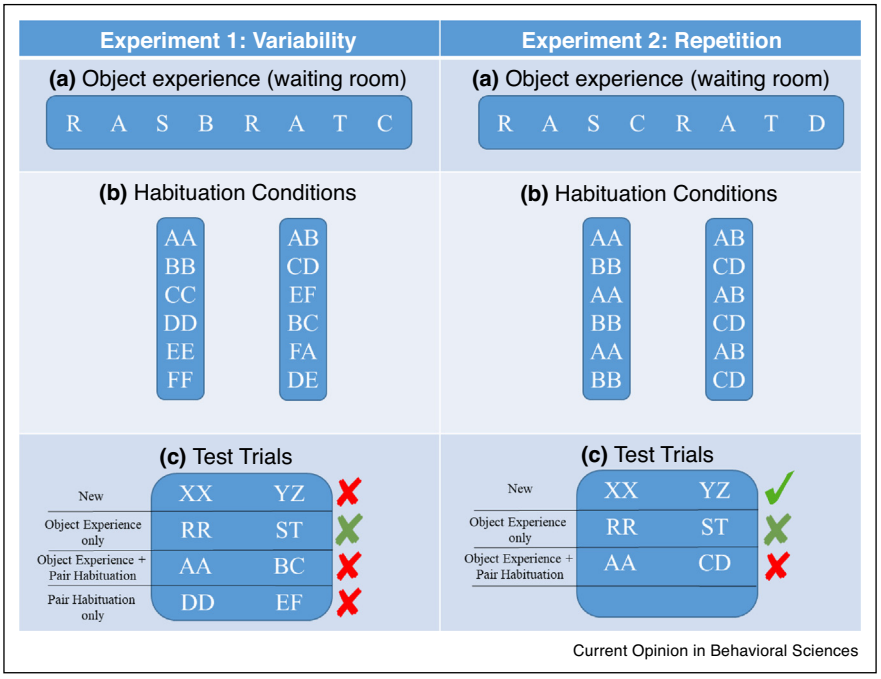
Our next study tested for relational abstraction at the earliest age possible and served as a base for capturing developmental changes in the learning process across age groups [24•]. We tested 3-month-old infants — the earliest age at which infants have the neck control to participate in a looking-time paradigm. As in the prior study, the key dependent measure is whether infants are able to differentiate the familiar relation (e.g. *same*, if habituated to *same*) from the unfamiliar one (e.g. *different*) when they see test pairs composed of new objects. The specific predictions were that, if infants are learning by comparison, then (1) relational learning should benefit from comparing a series of analogous exemplars and (2) performance on test pairs should be hampered for pairs that contain objects that were rendered individually salient through object experience before the experiment.

Learning theories broadly agree that increasing the variability in a set of exemplars should lead to a greater range of transfer [25–28]. Following this logic, young infants may require a larger training set than the four exemplars given to older infants in Ferry *et al.*'s study. Therefore, in the first experiment, we increased the number of exemplars seen in habituation to six. However, there is an alternate possibility — because alignment of relational structure is the *sine qua non* for discovering new relational commonalities, the ability to successfully compare and align exemplars is a prerequisite for relational learning. As discussed below, some studies have found that increasing the number and variability of examples can be detrimental to young children's relational learning, assumedly because their attention is drawn to the varying objects [29•,30]. To allow for this possibility, in our second experiment we gave infants two exemplars that alternated across habituation (see Figure 2).

The results revealed no evidence of learning the relation when 3-month-old infants were presented with six exemplars. However, the infants did learn the relation when they were presented with two alternating exemplars during habituation trials. In the two-exemplar condition, the 3-month-olds showed the key signature of analogical abstraction: they looked significantly longer at the novel relation during test when that relation was instantiated with new objects. This provides evidence that infants were able to transfer the relation to objects that they had not seen previously. In addition, there was evidence that object focus hindered learning. As in Ferry *et al.* [12•], there was no difference in looking time between the novel and familiar relations when instantiated by objects that had been made individually salient through pre-exposure. Moreover, there was a significant interaction between the new test trial type and object experience test trial type. These findings show that the signatures of analogical learning are present not only at 7 months [12•], but by 3 months of age [24•]. Clearly, language is not a necessary prerequisite for relational processing — the ability to carry out structural alignment and abstraction is in place well before the advent of language comprehension. However, although relational abstraction does

[1] One study has found that infants generalize linguistic patterns from a single exemplar, although only under certain conditions [19]. Currently, our lab is examining whether there are also contexts where infants could learn *same* and *different* from one exemplar [18].

Figure 2



Schematic of events in Anderson *et al*. [24•]. In Experiment 1 on the left, infants saw six exemplars during habituation trials. In Experiment 2 on the right, infants saw an alternation between two exemplars. **(a)** In the waiting room infants saw a subset of the individual toys before the experiment. **(b)** Infants were habituated to pairs of objects, either *same* or *different*. **(c)** In sequential test trials, looking time was recorded to the novel and familiar relational pairs across different types of test trials. Green check marks indicate conditions where there was significantly longer looking at the novel compared to the familiar relation. Green X indicates test conditions where, as predicted, infants failed to discriminate between the novel and familiar relations. Red Xs indicate test conditions in which we expected infants to discriminate between the novel and familiar relations, but they failed to do so.

not require language, Gentner and Christie have argued that language amplifies our analogical potential by inviting comparison and retaining the abstractions that result. In the other direction, we speculate that language learning may capitalize on analogical processes, both for semantic and for grammatical structures [31–33].

The finding that at 3 months infants formed a relational abstraction with two alternating exemplars but not with six exemplars seems at odds with the many findings indicating that increasing the number and variability of exemplars promotes generalization, in both animals [34–36] and humans [37–40,41•,42–44]. Yet, there are a few studies that align with the 'less is more' pattern [19,29•,30,45]. These findings may reflect a divide between studies in which the desired generalization depends on common object properties and those in which the desired generalization depends on relational commonalities. In the former case, more variability generally helps to broaden the generalization. But in order to form a relational abstraction, the learner must be able to carry out structural alignment over the exemplars. If the exemplars contain a variety of individual objects that look very different from one another, the learner may fail to align them. For example, in our studies with 3-month-olds, we suggest that repeated exposure to two exemplars allowed the infants to go beyond noticing only the individual objects to encoding the relations, which could then be aligned across exemplars (see Casasola [29•], for a similar account). The standard learning principle — 'Breadth of training predicts breadth of transfer' — is a useful rule, widely applicable for relatively concrete categories. But because alignment of relational structure is essential for discovering new relational commonalities, the ability to successfully compare and align is a prerequisite for relational learning [15•,24•]. Thus, as Gentner and Hoyos [15•] noted, the standard principle must be amended for relational learning to be 'Breadth of *alignable* training predicts breadth of transfer'. The differences described across 2, 4, or 6 exemplars address this issue by probing the factors that influence the encoding of the abstract relation.

Together, these experiments demonstrate that infants in the first year of life are capable of learning a *same/different* relation for pairs of objects with 6–9 habituation trials. These findings provide an interesting contrast to the comparative studies using similar tasks. Very few species

can learn the *same/different* relation for pairs of objects and for those few species that succeed, they require extensive training. For example, Wright and Katz [46] were able to train rhesus monkeys, capuchin monkeys and pigeons to distinguish *same* pairs from *different* pairs; however, to show full transfer to novel pairs, the two monkey species required over 4700 training trials and the pigeons required nearly 14 000 training trials. Flemming *et al.* [47] showed that rhesus monkeys could learn a *same/different* task with larger arrays and that they could subsequently succeed on a *same/different* task with pairs. But whether this species difference is viewed as a graded continuum, as much of this work suggests, or as a dichotomy, as Penn *et al.* [4] propose, it is clear that humans excel in relational ability. For a further discussion of the continuum of relational ability across species, as well as the point that humans stand out among species in having exceptional talent for relational learning please see Gentner *et al.* (this issue).

Conclusions

The *same/different* relation has perennial importance in the field of psychology dating back to the beginning of the field when William James stated in 1890 that the recognition and integration of the '*sense of sameness* is the very keel and backbone of our thinking' (p. 459) and 'the most important of all the features of our mental structure' (p. 460, quoted in Wasserman and Young) [36]. However, some key issues remain controversial — specifically, whether infants begin life with a set of core relations. Our failure to find evidence that *same* and *different* are present before engaging in comparison and abstraction argues against this possibility. Our studies demonstrate that infants have a relational processing mechanism that can compare across examples to form abstract relations. Future experiments need to focus on the distinction between possessing an *inherent* representation of *same* (and/or *different)* [9] versus having a learning process that allows the relation to be abstracted from input [12•,24•]. What is new about the contributions from the infant work is that *same/different* discrimination is present in the first year of life suggesting that the ability emerges before and independent of language. Moreover, the factors that facilitate and hinder relational learning in children and adults have similar effects on infant learning suggesting that the underlying mechanism may have continuity through development.

Conflict of interest statement

Nothing declared.

Acknowledgements

This material is based upon work supported by the National Science Foundation under Grant Nos. BCS-1423917 and BCS-1729720 to SH and DG. We thank Susan Carey and the McDonnell foundation network grant for hosting 'The ontogenetic origins of abstract combinatorial thought' symposium at Harvard in Summer of 2017 that served as the impetus for this special issue.

References and recommended reading

Papers of particular interest, published within the period of review, have been highlighted as:

- • of special interest

1. Gentner D: **Why we're so smart**. In *Language in Mind: Advances in the Study of Language and Thought*. Edited by Gentner D, Goldin-Meadow S. MIT Press; 2003:195-235.

2. Gentner D: **Bootstrapping the mind: analogical processes and symbol systems**. *Cogn Sci* 2010, **34**:752-775.

3. Goldwater MB, Schalk L: **Relational categories as a bridge between cognitive and educational research**. *Psychol Bull* 2016, **142**:729-757.

4. Penn DC, Holyoak KJ, Povinelli DJ: **Darwin's mistake: explaining the discontinuity between human and nonhuman minds**. *Behav Brain Sci* 2008, **31**:109-130.

5. Richland LE, Simms N: **Analogy, higher order thinking, and education**. *WIREs Cogn Sci* 2015, **6**:177-192.

6. Gentner D, Holyoak KJ, Kokinov BN: *The Analogical Mind*. The MIT Press; 2001.

7. Fodor J: *Language and Thought*. Harvard University Press; 1975.

8. Goddard C, Wierzbicka A: *Meaning and Universal Grammar*. John Benjamins Publishing Company; 2002.

9. Hochmann J-R, Carey S, Mehler J: **Infants learn a rule predicated on the relation same but fail to simultaneously learn a rule predicated on the relation different**. *Cognition* 2018, **177**:49-57.

10. Jackendoff R: **Semantic structures**. *Curr Stud Linguist* 1991, **19**.

11. • Tyrrell DJ, Stauffer LB, Snowman LG: **Perception of abstract identity/difference relationships by infants**. *Infant Behav Dev* 1991, **14**:125-129

The idea that abstract *same* and *different* relations are present from the start has had wide influence, particularly in comparative psychology, due to this pioneering work. This research suggested that 7-month-old humans spontaneously encode and transfer *same* and *different* relations from a single exemplar — implying that human infants can encode abstract *same-different* without training. Unfortunately, our attempted replication of this study failed, see Ferry *et al*. [12•] for more details.

12. • Ferry AL, Hespos SJ, Gentner D: **Prelinguistic relational concepts: investigating analogical processing in infants**. *Child Dev* 2015, **86**:1386-1405

This study tests the idea that infants can spontaneously encode and transfer *same* and *different* relations from a single exemplar. We failed to find support for this idea, however, if infants are given four exemplars they can abstract *same-different* pairs and generalize to new objects.

13. • Gentner D: **Structure-mapping: a theoretical framework for analogy**. *Cogn Sci Multidiscip J* 1983, **7**:155-170

This is the classic paper that introduced structure-mapping theory (cited over 6800 times in Google scholar as of September, 2020). The two mapping principles that pertain to the infant work are: (1) that relations between objects are preferentially highlighted, rather than the attributes of objects; (2) comparing across exemplars supports aligning their common structure and a series of comparisons can lead to gradual abstraction of the common structure. This theoretical framework distinguishes structure-mapping from spatial or purely featural accounts of similarity.

14. Forbus KD, Chang M, McLure M, Usher M: **The cognitive science of sketch worksheets**. *Top Cogn Sci* 2017, **9**:921-942.

15. • Gentner D, Hoyos C: **Analogy and abstraction**. *Top Cogn Sci* 2017, **9**:672-693

This review paper summarizes developmental evidence on relational learning through the process of analogical comparison. More specifically, this paper focus on the roles of alignment and language in learning processes for children. It concludes that more exemplars is not always better for learning. It is necessary to consider the learners ability to detect the relation between the exemplars to predict successful generalization.

16. Gentner D, Toupin C: **Systematicity and surface similarity in the development of analogy**. *Cogn Sci Multidiscip J* 1986, **10**:277-300.

17. Paik JH, Mix KS: **Preschoolers' use of surface similarity in object comparisons: taking context into account**. *J Exp Child Psychol* 2006, **95**:194-214.

18. Anderson EM, Chang Y-J, Hespos SE, Gentner D: **When one example behaves like many**. 2021, [in preparation].

19. Gerken L, Dawson C, Chatila R, Tenenbaum J: **Surprise! Infants consider possible bases of generalization for a single input example**. *Dev Sci* 2015, **18**:80-89.

20. Hochmann J-R, Benavides-Varela S, Fló A, Nespor M, Mehler J: **Bias for vocalic over consonantal information in 6-month-olds**. *Infancy* 2018, **23**:136-151.

21. Hochmann J-R, Benavides-Varela S, Nespor M, Mehler J: **Consonants and vowels: different roles in early language acquisition**. *Dev Sci* 2011, **14**:1445-1458.

22. Kovács AM, Endress AD: **Hierarchical processing in seven-month-old infants**. *Infancy* 2014, **19**:409-425.

23. Saffran JR, Aslin RN, Newport EL: **Statistical learning by 8-month-old infants**. *Science* 1996, **274**:1926.

24. • Anderson EM, Chang Y-J, Hespos S, Gentner D: **Comparison within pairs promotes analogical abstraction in three-month-olds**. *Cognition* 2018, **176**:74-86

This study tests whether *same-different* discrimination is present in 3-month-old infants. When infants see two exemplars that alternate and repeat, they were able to abstract the relation and generalize to new pairs. However, more was not better — when infants see six exemplars they were not able to learn the *same-different* relation. These findings provide evidence that relational learning is evident before and independent of language comprehension.

25. Markman AB, Wisniewski EJ: **Similar and different: the differentiation of basic-level categories**. *J Exp Psychol Learn Mem Cogn* 1997, **23**:54-70.

26. Rogers TT, McClelland JL: *A Parallel Distributed Processing Approach to Semantic Cognition: Applications to Conceptual Development*. Mahwah, NJ: Erlbaum; 2005.

27. Wasserman EA, Young ME, Fagot J: **Effects of number of items on the baboon's discrimination of same from different visual displays**. *Anim Cogn* 2001, **4**:163-170.

28. Xu F, Tenenbaum JB: **Word learning as Bayesian inference**. *Psychol Rev* 2007, **114**:245-272.

29. • Casasola M: **When less is more: how infants learn to form an abstract categorical representation of support**. *Child Dev* 2005, **76**:279-290

This study tests whether 10-month-old and 14-month-old infants can abstract the spatial relation of containment with everyday objects. They varied the number of different exemplars and tested whether the infants could generalize the relation to a new set of objects in test trials. They found that less was more, in that 14-month-old infants successfully generalized when presented with two exemplars but not with six exemplars. This paper, and earlier work (Casasola and Cohen), highlight that early in learning, infants seem to process the spatial event by first attending to the objects in the event and then attending to the relation between the objects. More advanced learners may represent the relations as well as the objects as part of their initial representation. However, in both cases, this view is consistent with Gentner's structure mapping theory, in particular that the ability to align the relation between the exemplars is the best predictor of learning.

30. Maguire MJ, Hirsh-Pasek K, Golinkoff RM, Brandone AC: **Focusing on the relation: fewer exemplars facilitate children's initial verb learning and extension**. *Dev Sci* 2008, **11**:628-634.

31. Gentner D, Christie S: **Mutual bootstrapping between language and analogical processing**. *Lang Cogn* 2010, **2**:261-283.

32. Gentner D, Namy LL: **Analogical processes in language learning**. *Curr Dir Psychol Sci* 2006, **15**:297-301.

33. Goldwater MB, Tomlinson MT, Echols CH, Love BC: **Structural priming as structure-mapping: children use analogies from previous utterances to guide sentence production**. *Cogn Sci* 2011, **35**:156-170.

34. Cooper JO, Heron TE, Heward WL: *Applied Behavior Analysis*. Merrill Publishing Company; 2007.

35. Thompson RKR, Oden DL, Boysen ST: **Language-naive chimpanzees (*Pan troglodytes*) judge relations between relations in a conceptual matching-to-sample task**. *J Exp Psychol Anim Behav Process* 1997, **23**:31-43.

36. Wasserman EA, Young ME: **Same–different discrimination: the keel and backbone of thought and reasoning**. *J Exp Psychol Anim Behav Process* 2010, **36**:3-22.

37. Bomba PC, Siqueland ER: **The nature and structure of infant form categories**. *J Exp Child Psychol* 1983, **35**:294-328.

38. Casasola M, Park Y: **Developmental changes in infant spatial categorization: when more is best and when less is enough**. *Child Dev* 2012, **84**:1004-1019.

39. Castro L, Kennedy PL, Wasserman EA: **Conditional same-different discrimination by pigeons: acquisition and generalization to novel and few-item displays**. *J Exp Psychol Anim Behav Process* 2010, **36**:23-38.

40. Gerken L: **Decisions, decisions: infant language learning when multiple generalizations are possible**. *Cognition* 2006, **98**:B67-B74.

41. • Gerken L, Bollt A: **Three exemplars allow at least some linguistic generalizations: implications for generalization mechanisms and constraints**. *Lang Learn Dev* 2008, **4**:228-248

This study tests 9-month-old infants ability to learn a stress pattern in linguistic input. They varied the number of different exemplars and tested whether the infants could generalize the rule to a new set of linguistic stimuli. Unlike Casasola, they found the more typical result that more was more. There was generalization when infants were given 3 different exemplars, but not when they were given one exemplar multiple times. In a second experiment, they found that 9-month-old infants did not learn when they substituted linguistic for non-linguistic sounds suggesting that the mechanism does not apply to all input equally.

42. Gómez RL: **Variability and detection of invariant structure**. *Psychol Sci* 2002, **13**:431-436.

43. Needham A, Dueker G, Lockhead G: **Infants' formation and use of categories to segregate objects**. *Cognition* 2005, **94**:215-240.

44. Quinn PC, Bhatt RS: **Learning perceptual organization in infancy**. *Psychol Sci* 2005, **16**:511-515.

45. Bulf H, Johnson SP, Valenza E: **Visual statistical learning in the newborn infant**. *Cognition* 2011, **121**:127-132.

46. Wright AA, Katz JS: **Mechanisms of same/different concept learning in primates and avians**. *Behav Processes* 2006, **72**:234-254.

47. Flemming TM, Beran MJ, Washburn DA: **Disconnect in concept learning by rhesus monkeys (*Macaca mulatta*): judgment of relations and relations-between-relations**. *J Exp Psychol Anim Behav Process* 2007, **33**:55.