Self statement for Mahesh Srinivasan, Assistant Professor of Psychology, University of California, Berkeley

# RESEARCH STATEMENT

Compared to other systems of animal communication, human language is unique in its expressive power. Through language, we can communicate an infinite number of thoughts using a finite set of words. Language also provides a system for conveying different perspectives toward the world (e.g., the same event can be called *chasing* or *fleeing*). My research explores the basis of linguistic expressivity in children, and how language provides a window onto cognition. I study how linguistic and conceptual representations interact in human development.

Since arriving at Berkeley in 2013, my work has focused on a phenomenon I call *lexical flexibility*: The use of a single word to express multiple, related ideas. Lexical flexibility is widespread in natural language, and follows systematic patterns. For example, in English, words can label animals and meat (thirsty *chicken* / tasty *chicken*), tools and actions (red *hammer* / *hammer* the nail), materials and artifacts (shattered *glass* / drinking *glass*), and more. My work explores whether lexical flexibility provides expressive power to language, by encoding different perspectives (e.g., *chicken* as an animal or source of meat) and supporting linguistic creativity, via the extension of words to new meanings (e.g., the tasty *warthog*).

To understand lexical flexibility, I consider the functional pressures that have shaped the evolution of linguistic structures more broadly. On the one hand, language is faced with the task of communicating an unbounded set of ideas through a finite set of words. This pressure could explain why ideas are compressed in the lexicon, such that individual words are used to express multiple ideas. However, this pressure alone does not explain *how* ideas are compressed in the lexicon: e.g., why words label animals and meat, tools and actions, and so on. To understand the latter, I consider learning pressures: If words have meanings that are related in transparent ways, they will be easier to learn, and more likely to become solidified in language. This perspective implies that flexible words have been adapted to cognition, and provide clues to how we think.

Although other scholars study language development, my focus on lexical flexibility is unique and engages four questions that confront psychology more generally. I have articulated these ideas in several written pieces over the past three years:

- **First, how do we use language creatively, to express new thoughts?** By most accounts, linguistic creativity derives from rules that combine morphemes into words, or words into sentences. But my research suggests that lexical flexibility provides another locus of creativity, by allowing children to extend words to new meanings from early in life (Srinivasan & Snedeker, 2014; Srinivasan, Al-Mughairy, Foushee & Barner, under revision).
- **Second, how do children learn new words?** Most researchers believe that, to simplify a complex learning problem, children assume that a new word will only label a single category of meaning. This predicts that children will have difficulty learning flexible words, which have multiple meanings. My research suggests the opposite: Children find lexical flexibility intuitive, and may leverage it to *facilitate* word learning (Rabagliati & Srinivasan, accepted; Rabagliati, Conte & Srinivasan, 2015; Srinivasan, 2016).
- **Third, what does language reveal about cognition**? If lexical flexibility has been shaped by learning pressures, then it may be adapted to cognition, and reflect how we construe the world. My research documents the role of cognitive constraints in shaping cross-linguistic

regularities in lexical flexibility (Srinivasan & Barner, 2013; Srinivasan & Rabagliati, 2015) and patterns in how words evolve new meanings (Xu, Malt & Srinivasan, under review).

- **Fourth, how does language learning affect cognitive development?** Learning that the same flexible word labels multiple concepts could teach children how those concepts are related. My recent work suggests how learning to use words flexibly affects children's conceptualization (Srinivasan, Berner & Rabagliati, in prep).

To address these questions, I conduct studies not only on how children learn language, but also on their developing cognitive abilities. Additionally, I conduct studies internationally, to explore cross-linguistic and cultural differences. Recently, my interest in lexical flexibility has also led me to explore how children's language use depends on their socio-pragmatic reasoning (Srinivasan, Chestnut, Li & Barner, 2013; Srinivasan, Bartnof, Foushee & Barner, in prep), and how children learn about the social world more generally (Dunham, Srinivasan, Dotsch & Barner, 2014; Srinivasan, Dunham, Hicks & Barner, 2015; Srinivasan, Kaplan & Dahl, in prep). Taken together, my recent work and future trajectory focus on five broad areas, which I will review below.

**1. How children learn new word meanings**

When learning a new word, children have to guess how it extends beyond its original exemplar. To address this inductive problem, researchers have proposed that a "taxonomic" assumption (Markman & Hutchinson, 1984) leads children to expect that a new word will be extended within a single category of exemplars (e.g., such that *chicken* will extend to all chicken animals). But this could lead to difficulty learning flexible words, which can label multiple kinds of exemplars (e.g., *chicken* can label animals or meat). To preserve a taxonomic assumption, children might incorrectly treat flexible word meanings as unrelated homophones (e.g., like *bat*, which separately labels baseball bats or animals) or conflate them into a single vague meaning (e.g., treating chicken animals and meat as members of the same category).

To understand the development of lexical flexibility, I explore whether children understand that the meanings of a flexible word are both related *and* distinct. Further, I test whether children use generalizations about flexible words to infer new word meanings.

*1.1 Early representations of flexible words*. My research finds that by at least age four, children do not represent the meanings of flexible words as unrelated homophones, but instead as related uses of the same word (Srinivasan & Snedeker, 2011, 2014). For example, when taught that a novel "muppet" word labels one meaning of a flexible word (e.g., that "blicket" labels chicken animals), children expect the muppet word to also label the other meaning (i.e., chicken meat), but do not do the same for homophones like *bat* (baseball vs. animal). Other recent work from my lab indicates that children also understand how the meanings of flexible words are distinct (Rabagliati, Conte & Srinivasan, 2015). In particular, although shared labels often lead children to think that perceptually-dissimilar items are members of a common category that share properties (e.g., a dove and a flamingo are both "birds"), children do not conflate the different meanings of flexible words into a broad category. For example, we find that children do not think that properties that are true of "chicken" meat need also be true of "chicken" animals.

*1.2 Using flexibility to infer new word meanings*. Many flexible words form patterns: e.g., *hammer*, *shovel* and *washer* all label tools and functional uses of those tools. My work indicates that, by at least age four, children use generalizations about these patterns to infer new meanings for words (Srinivasan, Al-Mughairy, Foushee & Barner, under revision; Srinivasan & Snedeker, 2014). For example, after learning that *daxing* labels a functional use of a novel tool, children spontaneously expect the tool itself to be called a *dax*, similar to how familiar flexible words like *shovel* and *washer* are used. This suggests that children can use generalizations about lexical flexibility to infer new word meanings, even without receiving direct evidence for them. Critically, this learning advantage may help explain why lexical flexibility exists: It may be easier to learn a lexicon in which words are linked to multiple meanings in predictable ways, than one in which each meaning is expressed through a unique word (Rabagliati & Srinivasan, accepted; Srinivasan, 2016). Ongoing research in my lab – using preferential-looking, corpora analyses, and computational modeling – is testing this idea.

*1.3. Using linguistic structure to learn abstract words*. The finding that children leverage lexical flexibility to infer new word meanings fits with a broader proposal that children rely on linguistic structure to learn many words (Gleitman, 1990). For example, words like "yesterday" and "tomorrow" are difficult to learn from perception, because they denote abstract temporal periods relative to the moment they are uttered: Monday's "yesterday" is different than Friday's. While children produce these words from around age 2, they use them in erroneous ways for several subsequent years. My research (Tillman, Marghetis, Barner & Srinivasan, under review) suggests that despite their errors, children have systematic, partial meanings for these words. This reflects a gradual inductive process through which children use linguistic cues (e.g., syntax and discourse) to learn the meanings of these words (e.g., that "last week" is in the past). This strategy, of leveraging linguistic structure to constrain word meanings, may be critical for abstract words, which denote phenomena that are difficult to reference directly.

**2. Cognitive constraints on language**

Language has long provided clues for theories about cognition. For example, the use of *newspaper* to label an object (*ripped newspaper*), its content (*interesting newspaper*), and the organization that creates it (*The newspaper is hiring*), could reveal how we construe artifacts (Pustejovsky, 1995). Further, metaphorical uses of words like *grasp* (e.g., *grasp* an object/idea) could reveal parallels among abstract and concrete concepts (Lakoff & Johnson, 1980). My research reveals cognitive constraints on lexical flexibility, by documenting regularities across languages, and patterns in how words have evolved new meanings.

*2.1. Cross-linguistic variation in lexical flexibility*. What can we conclude from observing that we use the same word to label multiple ideas? Are the conceptual relations between these ideas privileged, or is this grouping an arbitrary convention that speakers have to learn? My research suggests that flexible words are not arbitrary conventions, because most patterns of flexibility that are present in English are also attested in other languages (Srinivasan & Rabagliati, 2015). Instead, I argue that flexible words have been shaped by learning pressures, and are thus adapted to cognitive constraints (Rabagliati & Srinivasan, accepted; Srinivasan, 2016). This proposal predicts that patterns that are less prevalent across languages may also be more difficult to learn. Consistent with this, one pattern that is rare across languages–verbs that

describe transfers of substances from sources, like "*milk* the cow", or "*weed* the garden"–is also difficult for children to learn (Srinivasan & Barner, 2013). Four-year-olds struggle to understand verbs like *milk*, because they assume that they describe transfers to goals (*milk* the cow means "put milk on the cow"). Ongoing work in my lab directly explores the relation between cross-linguistic regularities and learnability, via computational analyses of co-lexicalization patterns from over 200 languages.

*2.2. Historical evolution of word meanings*. Many flexible words have meanings that are related metaphorically, as in the *grasping* of an object vs. an idea. By some accounts, these words reveal that concrete and embodied concepts are used to think about more abstract concepts (Lakoff & Johnson, 1980). This predicts that, over a language's history, words with concrete meanings will be extended to describe more abstract meanings. My lab has tested this idea, by using computational models to study metaphorical extensions of English words over the past millennium (Xu, Malt & Srinivasan, under review). We find that words that denote phenomena in the external world are more likely to have been extended to describe more internal phenomena, compared to the reverse. This provides the first large-scale evidence that words are extended to new meanings in predictable ways, and that these extensions are subject to cognitive and communicative constraints.

*3.4. Cognitive constraints on artifact design*. The sections above suggest that words–which are often thought of as cultural conventions–are adapted to basic features of cognition. Might the same be true of other cultural artifacts? One candidate is the abacus. The fact that the abacus is a descendant of the oldest human computing devices raises the possibility that it may have evolved to fit properties of human perception and cognition. Following a recent educational intervention in which our team found that abacus training substantially improves mathematical ability (Barner, Alvarez, Sullivan, Brooks, Srinivasan & Frank, 2016), I have recently explored whether abacus training shapes how abacus experts allocate their visual attention toward the abacus. My research finds that even naïve subjects–who have never used an abacus before–behave similarly to experts, and attend toward semantically-relevant aspects of the abacus (Srinivasan, Wagner, Frank & Barner, under review). This suggests that the design of the abacus may have evolved under perceptual and cognitive constraints.

**3. Effects of language learning on cognition**

According to some theories, language not only reveals – but also shapes – how we think (Whorf, 1956). Flexible uses of words provide a plausible mechanism through which language could affect cognition: Learning that the same word labels multiple concepts could teach children how those concepts are related. My work explores whether learning flexible words affects children's conceptualization and learning. I also test whether speakers of different languages might think differently about the world, due to differences in the languages they have learned.

*3.1. Lexical flexibility and conceptualization*. How do children reason about the structure of a new category? Prior studies suggest that children expect objects of similar shapes to be members of the same category (Landau, Smith & Jones, 1988). My recent work shows that children can make intelligent inferences about the structure of a new category by using information from lexical flexibility (Srinivasan, Berner & Rabagliati, in prep). We find that if children learn that a novel word that labels a material (some *dax*) also labels an object (a *dax*),

children extend the object label to other objects sharing the same material, regardless of their shape. In new work, I am exploring other ways that lexical flexibility shapes children's conceptualization. For example, I test whether learning that a word for an object (a *dax*) also labels a function of that object (it is *daxing*) leads children to think that the object has been specifically designed for that function (*daxes* are for *daxing*).

*3.2. Spatial metaphors and cross-domain associations*. In English, we use the language of space to describe temporal duration (*long*, *short*), auditory pitch (*high*, *low*), and number (*big*, *small*). Does learning metaphorical words create cross-domain associations? My research provides evidence that language may not have this effect: Even 9-month-olds, who have not yet learned words like *long* or *short*, perceive similarities between "long" lines and "long" sounds (Srinivasan & Carey, 2010). This suggests that metaphor reflects pre-existing structural parallels or overlap between concepts (see also Matlock, Holmes, Srinivasan & Ramscar, 2011). Ongoing work in my lab is characterizing the mental link between space and time in children, by documenting how children systematically use space – in their spontaneous gesture – when talking about time (Marghetis, Tillman, Srinivasan & Barner, 2014)

*3.3. Linguistic relativity*. The relationship between language and thought can studied not just in development, but also by exploring whether speakers of different languages think differently about the world. I have pursued this approach in previous work on Mandarin Chinese (Srinivasan, 2010). In contrast to English, where count nouns can be pluralized, Mandarin requires the use of *measure phrases* to quantify objects (e.g., "I have two *long-thing* of snake"). These measure phrases are used flexibly, to classify different objects (e.g., the same measure phrase applies to snakes, scarves, and pants). Consistent with the idea that learning measure phrases affects quantification, my studies show that Mandarin speakers have difficulty counting a target object (like snakes) when they have to ignore distractor objects that share the same measure phrase (like scarves). I have recently contributed a theoretical piece on the relationship between mass-count syntax and quantification (Srinivasan & Barner, in press), and ongoing work in my lab explores quantification in Tseltal, a Mayan language that lacks mass-count syntax.

**4. Language and socio-pragmatic reasoning**

Above, I have discussed cognitive constraints on language, but language comprehension also relies heavily on our ability to reason about the knowledge, beliefs, and intentions of interlocutors (Grice, 1969). Thus, if a friend asks us to "Pick a *blicket* up from the table", we assume that she doesn't want a *cup* from the table, because otherwise she would have said so; Thus, *blicket* must refer to another object (Clark, 1987). My research traces the foundations of socio-pragmatic reasoning and inference in children.

*4.1. Children's understanding of conventionality*. We can communicate because our words are socially-shared, *conventional* symbols. Adults have clear intuitions about which words are conventional, but these intuitions belie a complex learning problem: Although some common words like "book" are shared by most English speakers, others like "allomorph" are only conventional within a more restricted community. The literature has largely concluded that children initially assume that all common nouns are known by others (Diesendruck & Markson, 2001). My studies challenge this conclusion by showing that children do not attribute knowledge

of a newly-learned word to a previously absent individual (Srinivasan, Bartnof, Foushee & Barner, in prep). Further, I show that children's reasoning about conventionality is linked to their developing theory-of-mind. New studies in my lab are exploring the conditions that lead children to attribute knowledge of new words to others.

*4.2. Children's understanding of subjectivity in language*. Evaluating the truth of an utterance can require not only considering the state of the world, but also the perspectives of an interlocutor. For example, speakers can disagree about whether a building is *pretty* (or *boring*, etc.), or whether it is *tall* (or *big*, etc.), without either being at fault. In contrast, if speakers disagree about whether a building is *striped* (or *spotted*, etc.), one speaker must be wrong. Are children sensitive to these differences in subjectivity? Studies from my lab find that even 7-year-olds rarely permit faultless disagreement for adjectives like *pretty* and *tall*, and state that speakers who side with their own egocentric perceptions are correct (Foushee & Srinivasan, 2016). Interestingly, children are sensitive to *why* speakers disagree (e.g., due to their different perspectives), but do not use this to ground judgments of linguistic truth. Ongoing studies in my lab explore how children ultimately construct an understanding of linguistic subjectivity.

*4.3 Pragmatic inference and word meaning*. Children between ages 3 and 7 make a puzzling failure when interpreting object labels: When asked to "count the *shoes*" and presented with two whole shoes and a third cut into two arbitrary parts, children count each shoe part as a "shoe", resulting in a count of four shoes (Shipley & Shepperson, 1990). My work suggests that children count parts as wholes because they fail to make a pragmatic inference: If the experimenter had wanted shoe parts to be counted, she would have said to count "*pieces of* shoe" (Srinivasan, Chestnut, Li & Barner, 2013). This research addresses centuries-old speculation about the nature of word meanings and suggests that we decide what a word refers to in part by contrasting it with alternative utterances. New studies in my lab are exploring how pragmatic inferences might affect stereotype formation: Does hearing that "Boys are good at math" lead children to infer that girls are not good at math?

**5. Learning about the social world**

Recently, my interest in pragmatics has generated a productive line of work on how children learn about their social and cultural world. This work explores how children learn and reason about the social norms that govern behavior, and develop biases toward or against members of different social groups (e.g., religion, caste). Further, I study the effects of social status on children's beliefs about themselves and their attitudes toward academics and learning.

*5.1. Reasoning about social norms*. Violations of social norms come in two forms: Transgressions that violate social conventions (e.g., dressing inappropriately at school), and transgressions of moral norms (e.g., hitting someone) that are intrinsically wrong because they result in harm. Although previous studies find that preschoolers distinguish between familiar moral and conventional transgressions (Turiel, 1983), my work shows that children make this distinction for novel transgressions as well, and do so rapidly, on the basis of a small set of social signals (e.g., by observing a victim's distress; Srinivasan, Al-Mughairy, Kaplan & Dahl, 2015). Other work from my lab has explored how Hindu and Muslim children reason about norms that differ between their respective religions (Srinivasan, Kaplan & Dahl, in prep). We find that

children do not expect members of other religions to follow their own religion's norms. Further, children draw a distinction between religious and moral norms, by resisting the idea that "God" can make it permissible to harm others. Future work will explore the conditions that promote the development of tolerant attitudes.

*5.2. Social status and intergroup bias*. Studies of implicit bias have found that while members of higher-status groups (e.g., Whites in the US) exhibit strong ingroup biases, members of lower-status groups (e.g., Blacks or Hispanics) sometimes exhibit biases *against* their own group (Newheiser & Olson, 2012). This is important because negative biases toward one's own group are linked to worse educational and health outcomes. My work has explored the relation between social status and ingroup bias in Indian children's biases toward religious and caste groups. Similar to the case of race, we find that members of lower castes show weaker ingroup biases than members of higher castes. But religion functions differently: We find that lower-status Muslim children show strong ingroup biases, suggesting that religion insulates group members from internalizing stigma (Dunham, Srinivasan, Dotsch & Barner, 2014). My ongoing work in India explores how a child's intergroup biases relate to their position within a social network (e.g., whether they have inter-religious or inter-caste friends). This will provide a basis for interventions that target "influential" individuals within social networks.

*5.3. Attitudes toward academics*. Children from socially and economically disadvantaged groups often achieve less in school than children from more advantaged backgrounds, thus perpetuating existing social inequalities. My work tests psychological explanations for these gaps: Children of lower social status may be less likely to adopt a "growth mindset" (Dweck, 2006), and believe that their academic achievement can be increased via effort. Consistent with this, I have found that Indian children who believe that caste plays an important role in society are less likely to subscribe to a growth mindset (Srinivasan, Dunham, Hicks & Barner, 2015). This work documents the key role of culture and social structure in shaping children's attitudes. Ongoing work in my lab explores the factors that promote math anxiety among economically-disadvantaged children, and how children's concepts of what "math" is relate to their anxiety.

## WORKS CITED


Barner, D., Alvarez, G., Sullivan, J., Brooks, N., Srinivasan, M. & Frank, M. C. (2016). Learning mathematics in a visuospatial format: A randomized, controlled trial of mental abacus instruction. *Child Development*, *87*(4), 1146-1158.

Clark, E. V. (1987). The principle of contrast: A constraint on language acquisition. *Mechanisms of language acquisition*, *1*, 33.

Diesendruck, G., & Markson, L. (2001). Children's avoidance of lexical overlap: A pragmatic account. *Developmental psychology*, *37*(5), 630.

Dunham, Y., Srinivasan, M., Dotsch, R. & Barner, D. (2014). Religion insulates ingroup evaluations: The development of intergroup attitudes in India. *Developmental Science*, *17*(2), 311-319.

Dweck, C. (2006). *Mindset: The new psychology of success*. Random House.

Foushee, R. & Srinivasan, M. (2016). Sensing subjectivity: Children's semantic and epistemological development. Poster presented at the 42nd Annual Meeting of the Society for Philosophy and Psychology, Austin, TX.

Gleitman, L. (1990). The structural sources of verb meanings. *Language acquisition*, *1*(1), 3-55.

Grice, P. (1969). Utterer's meaning and intensions. *The Philosophical Review, 68,* 147-177.

Lakoff, G., & Johnson, M. (1980). *Metaphors we live by*. Chicago: The University of Chicago Press.

Landau, B., Smith, L. B., & Jones, S. S. (1988). The importance of shape in early lexical learning. *Cognitive Development*, *3*(3), 299-321.

Marghetis, T., Tillman, K., Srinivasan, M. & Barner, D. (2014). Linking space and time in the child's mind: The case of gesture. Paper presented at the 36th Annual Cognitive Science Conference, Quebec City, Canada.

Markman, E. M., & Hutchinson, J. E. (1984). Children's sensitivity to constraints on word meaning: Taxonomic versus thematic relations. *Cognitive psychology*, *16*(1), 1-27.

Matlock, T., Holmes, K.J., Srinivasan, M., & Ramscar, M. (2011). Even abstract motion influences the understanding of time. *Metaphor and Symbol*, *26*(4), 260-271.

Newheiser, A., & Olson, K. R. (2012). White and Black American children's implicit intergroup bias. *Journal of Experimental Social Psychology, 48*, 264-270.

Pustejovsky, J. (1995). *The Generative Lexicon*. Cambridge: MIT Press.

Rabagliati, H. & Srinivasan, M. (accepted). Sense Relations. To appear in *Handbook of Experimental Semantics and Pragmatics*, Oxford University Press.

Rabagliati, H., Conte, S., & Srinivasan, M. (2015). Words as invitations to form categories? The case of polysemy. Poster presented at the 40th Annual Boston University Conference on Language Development, Boston, MA.

Shipley, E., & Shepperson, B. (1990). Countable entities: Developmental changes. *Cognition, 34,* 109-136.

Srinivasan, M. (2010). Do classifiers affect cognitive processing? A study of nominal classification in Mandarin Chinese. *Language and Cognition*, *2*(2), 177-190.

Srinivasan, M. (2016). Concepts as explanatory theories: Evidence from word learning and the development of lexical flexibility. In D. Barner and A. Baron, *Core Knowledge*

*and Conceptual Change*, Oxford University Press.

Srinivasan, M., Al-Mughairy, S., Foushee, R., Barner, D. (under revision at *Cognition*). Learning language from within: Children use semantic generalizations to infer new word meanings.

Srinivasan, M., Al-Mughairy, S., Kaplan, E. & Dahl, A. (2015). Preschoolers' reactions to novel moral and conventional violations. Poster presented at the 9th Biennial Meeting of the Cognitive Development Society, Columbus, OH.

Srinivasan, M. & Barner, D. (2013). The Amelia Bedelia effect: World knowledge and the goal bias in language acquisition. *Cognition*, *128*, 431-450.

Srinivasan, M., & Barner, D. (in press). Encoding individuals in language using syntax, words, and pragmatic inference. *WIREs Cognitive Science*.

Srinivasan, M., Bartnof, A., Foushee, R. & Barner, D. The scope of conventionality: Do children expect newly-learned words to be mutually known? Manuscript in preparation.

Srinivasan, M., Berner, C., & Rabagliati, H. Children use of polysemy to structure new object categories. Manuscript in preparation.

Srinivasan, M. & Carey, S. (2010). The long and the short of it: On the nature and origin of functional overlap between representations of space and time. *Cognition*, *116*, 217-241.

Srinivasan, M., Chestnut, E., Li, P., & Barner, D. (2013). Sortal concepts and pragmatic inference in children's early quantification of objects. *Cognitive Psychology*, *66*, 302-326.

Srinivasan, M., Dunham, Y., Hicks, C. & Barner, D. (2015). Do attitudes toward societal structure predict beliefs about free will and achievement? Evidence from the Indian caste system. *Developmental Science*, *19*(1), 109-125.

Srinivasan, M., Kaplan, E., & Dahl, A. How do children reason about religious doctrines? Evidence from Hindu and Muslim children in India. Manuscript in preparation.

Srinivasan, M. & Rabagliati, H (2015). How concepts and conventions structure the lexicon: Cross-linguistic evidence from polysemy. *Lingua*, *157*, 124-152.

Srinivasan, M. & Snedeker, J. (2011). Judging a *book* by its cover and its contents: The representation of polysemous and homophonous meanings in four-year-old children. *Cognitive Psychology*, *62*, 245-272.

Srinivasan, M. & Snedeker, J. (2014). Polysemy and the taxonomic constraint: Children's representations of words with taxonomically-different meanings. *Language Learning and Development*, *10*(2), 97-128.

Srinivasan, M., Wagner, K., Frank, M.C. & Barner, D (under review at *Cognitive Science*). Does expertise affect the allocation of visual attention? The case study of mental abacus.

Tillman, K., Marghetis, T., Barner, D. & Srinivasan, M (under review at *Cognitive Psychology*). Today is tomorrow's yesterday: Children's acquisition of deictic time words.

Turiel, E. (1983). *The development of social knowledge: Morality and convention*. Cambridge: Cambridge University Press.

Whorf, B.L. (1956). *Language, thought, and reality: selected writings of Benjamin Whorf*. Cambridge: MIT Press.

Xu, Y., Malt, B. & Srinivasan, M (under review at *Science*). Evolution of word meanings through metaphorical mapping: Systematicity over the past millenium.