Application for a Grant

Internal use

503377

Identification

This page will be made available to selection committee members and external assessors.

Funding opportunity

Insight Grants

Joint or special initiative

Application title

Gestures as a potential cue to children's verb learning

Applicant family name	Applicant given name	Initials
Nicoladis	Elena	

Org. code	Full name of applicant's organization and department
1480111	University of Alberta Psychology

Org. code	Full name of administrative organization and department
1480111	University of Alberta Psychology

Scholar type   Regular ⦿   New ◯   Research Group

If New, specify category   1 ◯ 2 ◯ 3 ◯ 4 ◯   435-2

Does your proposal require a multidisciplinary evaluation?   Yes ◯ No ⦿

Does your proposal involve human beings as research subjects? If "Yes", consult the *Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans* and submit your proposal to your organization's Research Ethics Board.   Yes ⦿ No ◯

Does your proposal involve activity that requires a permit, licence, or approval under any federal statute; or physical interaction with the environment? If 'Yes', complete Appendices A and B.   Yes ◯ No ⦿

	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Total funds requested from SSHRC (from page 9)	47,840	98,439	105,111	103,798	105,670	460,858

Application WEB
2011/10/13

PROTECTED B WHEN COMPLETED

Family name, Given name
Nicoladis, Elena

Participants

List names of your team members (co-applicants and collaborators) who will take part in the intellectual direction of the research. Do not include assistants, students or consultants.

Role
Co-applicant ●   Collaborator ○

Family name	Given name	Initials
Marentette	Paula	F

Org. code	Full organization name
1480111	University of Alberta

Department/Division name
Augustana Faculty

Role
Co-applicant ○   Collaborator ○

Family name	Given name	Initials

Org. code	Full organization name

Department/Division name

Role
Co-applicant ○   Collaborator ○

Family name	Given name	Initials

Org. code	Full organization name

Department/Division name

Role
Co-applicant ○   Collaborator ○

Family name	Given name	Initials

Org. code	Full organization name

Department/Division name

Role
Co-applicant ○   Collaborator ○

Family name	Given name	Initials

Org. code	Full organization name

Department/Division name

Application WEB

PROTECTED B WHEN COMPLETED

Family name, Given name
Nicoladis, Elena

Research Activity

The information provided in this section refers to your research proposal.

Keywords

List keywords that best describe your proposed research or research activity. Separate keywords with a semicolon.

language acquisition; word learning; verbs; children; gestures

Priority Areas - Priority area(s) most relevant to your proposal.

Disciplines - Indicate and rank up to 3 disciplines that best correspond to your activity.

Rank	Code	Discipline	If "Other", specify
1	62416	Language Acquisition	
2	62400	Linguistics	
3	63004	Child and Adolescent Psychology	

Areas of Research

Indicate and rank up to 3 areas of research related to your proposal.

Rank	Code	Area
1	120	Communication
2	111	Children
3		

Temporal Periods

If applicable, indicate up to 2 historical periods covered by your proposal.

From	To
Year BC AD	Year BC AD

Application WEB

PROTECTED B WHEN COMPLETED

Social Sciences and Humanities
Research Council of Canada

Conseil de recherches en
sciences humaines du Canada

| Family name, Given name |
| Nicoladis, Elena |

Research Activity (cont'd)

Geographical Regions
If applicable, indicate and rank up to 3 geographical regions covered by or related to your proposal. Duplicate entries are not permitted.

Rank	Code	Region
1		
2		
3		

Countries
If applicable, indicate and rank up to 5 countries covered by or related to your proposal. Duplicate entries are not permitted.

Rank	Code	Country	Prov./ State
1			
2			
3			
4			
5			

Application WEB

PROTECTED B WHEN COMPLETED

Family name, Given name

Nicoladis, Elena

Response to Previous Critiques - maximum one page

Applicants may, if they wish, address criticisms and suggestions offered by adjudication committees and external assessors who have reviewed previous applications.

Personal information will be stored in the Personal Information Bank for the appropriate program.

Application Web

Page 5

PROTECTED B WHEN COMPLETED

Family name, Given name
Nicoladis, Elena

Summary of Proposed Research

The summary of your research proposal should indicate clearly the problem or issue to be addressed, the potential contribution of the research both in terms of the advancement of knowledge and of the wider social benefit, etc.

Verbs are harder than nouns for children to learn. This research project will test two central hypotheses about verb learning in children: First, in experimental situations, children benefit from co-speech gesture as shown by enhanced verb learning. Second, in everyday interaction, children use the co-speech gesture they observe to discern the meaning of verbs. Evaluation of these claims will enable us to identify the effectiveness of co-speech gesture as a support for a particularly challenging area of language acquisition.

Unlike nouns, which for young children tend to be linked to concrete referents providing better opportunities for imagery (McDonough et al., 2011), verbs are more abstract and their meaning harder to point to in the environment. Also, nouns are more likely to be present in the context of a discussion, unlike verbs that are highly flexible in context and timing of use. For example, verbs are used to discuss past and future events. These factors make their meaning much harder for a child to extract. Previous research has shown that children tend to be very cautious in their first interpretations of verbs. This bias toward caution can be overcome with cues from the grammar of a sentence or cues from the physical or social environment. This project will focus on co-speech gesture as one of several social and pragmatic cues that may support children's mastery of verbs.

We argue that co-speech gesture is a particularly appropriate cue to verb meaning because it addresses two features that make verbs hard: i) temporal asynchrony, and ii) abstraction. First, co-speech gesture is closely timed to accompany speech (Graziano, Nicoladis & Marentette, submitted) therefore even if a parent is talking about a past or future event, an accompanying gesture can clarify the meaning of a particular phrase. Second, representational gestures render spatial and action based concepts concrete by providing a perceptually linked source of supplementary or complementary information to the stream of speech they accompany (Goldin-Meadow & Beilock, 2010).

We have designed both experimental and observational studies to address our central questions: First, can children use gestures to support verb learning? We will use experimental studies to determine the aspects of verb use that co-speech gesture might reasonably be expected to influence. Three studies will reveal whether or not children can be lead to quicker or more accurate verb learning by manipulating gestures to provide additional information regarding agent/instrument, source/goal, and manner/path. Second, do children use gestures to support verb learning? Given the results from the first three studies, we will implement two observational studies to determine whether parents actually use co-speech gesture in natural settings and further whether children who observe these gestures benefit from their use.

We anticipate that the results of these studies will reveal that co-speech gesture can be used experimentally to enhance verb learning, and further that children whose parents use co-speech gesture have a linguistic advantage. These outcomes will be conveyed to both the academic community and the general public through publications in scholarly and general-interest periodicals, conference presentations and organization, and the development and maintenance of a website. Over the period of a five-year grant, we would be able to provide many opportunities for the training of undergraduate research assistants, graduate students and postdoctoral fellows.

Personal information will be stored in the Personal Information Bank for the appropriate program.

Application WEB

Page 6

PROTECTED B WHEN COMPLETED

Objectives

Relative to nouns, verbs are hard for children to learn (Gentner, 2006; Gleitman et al., 2005). Nouns are often acquired earlier and in greater frequency, a finding confirmed across multiple languages using checklist studies (Bornstein et al., 2004; Gentner, 1982; Tardif et al., 1999), picture naming studies (Kauschke, Lee & Pae, 2007), and experimental acquisition tasks (Childers & Tomasello, 2006; Imai et al., 2008). Verbs are harder to learn because, unlike nouns, they occur across a wide range of objects in multiple contexts. Given this diversity, how is the child to identify the common set of circumstances picked out by a verb? Consider the verb *to give* in the following sentences: "Give me the book", "A cow gives milk", "Give me a break", "Give me your attention", "I'm going to give you another time out". The child must map the commonality in all of those contexts, prototypically related to a change of ownership (therefore, often location) of some thing (that could be abstract) by an agent (who is usually animate) to a recipient (who is also usually animate). We will argue that, at least in some instances, gestures have features that might help children restrict the possible interpretations of verbs. In our previous research we have shown that children are more likely to interpret an observed gesture as an action associate, providing information about the things you can do with an object rather than assuming the gesture is a label for an object (Marentette & Nicoladis, in press). One implication of this finding is that children may be predisposed to use information in co-speech gesture as a source of information about verbs, particularly if they encode the movement of a particular object.

We propose to examine whether the co-speech gesture of children's conversational partners serves as a particularly effective cue to support the development of "hard words" such as verbs (Gleitman et al., 2005). In everyday interactions, co-speech gestures are synchronous with similar-meaning speech (Graziano et al., submitted; McNeill, 1992); for example a speaker might produce a flat palm-up "give" gesture while saying "Give me the candy". For adults, the meaning of co-speech gesture is often redundant with the meaning of the co-occurring speech. For young children co-speech gestures therefore convey meaningful and synchronous clues allowing them to discern how to map events in the world to the meaning of "hard words" such as verbs.

In the detailed description we give here, we review the literature on verb learning and the factors that influence it as well as the literature on co-speech gesture and why it might play a particular role in verb acquisition. In the proposed experimental and observational studies, we test whether gesture serves as a largely untested cue to verb meaning. **Can** children use gesture as a cue to map the meaning of a new verb onto an event? In practice, **do** they?

Results of the proposed studies will provide critical input to theoretical claims that preschool age children interpret syntactic and lexical knowledge in light of social and pragmatic factors (Golinkoff & Hirsh-Pasek, 2008). In addition, demonstrating the circumstances under which co-speech gesture supports language development will provide clinicians with another tool to assess, and perhaps successfully intervene in children's lexical development.

Context: Why are verbs hard to learn?

Quine (1964) pointed out that unknown words have potentially an infinite number of meanings. Language-learning children use a variety of cues to infer the meanings of words, including social and pragmatic cues (e.g., Baldwin, 1991; Bloom, 2000; Diesendruck et al., 2006) and, when some language has been acquired, they can also use syntactic and semantic cues to infer word meaning (Bélanger & Hall, 2006; Booth & Waxman, 2003; Golinkoff et al., 1996; Naigles, 1990). Children's verb learning has been studied from a number of theoretical perspectives, with two common themes emerging that provide important background: 1) verbs tend to be hard for children to learn and 2) children tend to be conservative in their generalization of verb meaning. In the present literature review, we highlight how learning verbs may be challenging for children. Our purpose in doing so is to identify aspects of verb learning that may be aided by gestures, a topic we will address in the following section.

Verbs usually refer to actions or events that take place over time and so can refer to less physically stable or concrete referents than nouns (e.g., Gentner, 1982; 2006). Verbs are hard because children must map one word to varying sets of information from an event (e.g., Imai et al., 2005). Selecting which elements of an event are picked out by a word is a particularly challenging task. Children seem to learn nouns in naturalistic settings after fewer instances of exposure compared to verbs (Chan & Nicoladis, 2010; see also Naigles & Hoff-Ginsberg, 1998) and take longer to pick verbs out of the morphological context than nouns (Veneziano & Parisse, 2011). Some experimental studies have shown that it is easier for both adults and children to identify the precise meaning of nouns than verbs from naturalistic interactions (Snedeker & Trueswell, 2004). In these studies, participants are shown silent video clips of mothers interacting with children, with a beep replacing either a target noun or a target verb. Participants in one study successfully guessed the precise meaning of almost half the nouns and about 15% of the verbs (Gillette et al., 1999; see Gleitman et al., 2005 for a review).

In verb-learning experiments, children under the age of five years show a strong tendency to extend the meaning of a novel verb to a new action performed by the same agent rather than the same action performed by a different agent (see Imai et al., 2005 for cross-linguistic evidence; see Kersten & Smith, 2002 for evidence that this effect is particularly strong with novel objects). Similarly, three-year-old children are sometimes initially overly conservative in associating a verb with the instrument they observed being used to perform the action (Forbes & Farrar, 1993). Childers (2011) found that cross-situational exposure supported generalization of verbs in children aged 2 ½ years, a finding similar to that of Forbes and Farrar (1995) who showed that exposure to multiple instruments or outcomes enabled 3 year old children to generalize (but see Maguire, Hirsh-Pasek, Golinkoff, & Brandone, 2008). These results could be linked to children's initial tendency to be conservative in extending the use of words, using verbs only in the same or similar constructions to ones previously used (Tomasello, 2000).

Another tendency in verb-learning experiments is a source bias. Fisher et al. (1994) showed that children have a conceptual bias influenced by syntactic framing in interpreting novel perspective verb pairs (i.e., verbs like *chase/flee* which both accurately describe a single scene). When shown a scene of an rabbit running after an elephant while hearing the transitive sentence "Look! The rabbit is thorping the elephant!", children tend to interpret the meaning of *thorp* as 'chase'. When told "The elephant is thorping" they interpret the novel intransitive verb as "flee". Nappa et al. (2009) have shown that social information such as eye gaze can alter the predisposition to source interpretations (i.e., favouring chase) but only of a non-specific phrase such as "he's thorping him".

Another bias in children's verb-learning can be identified in motion verbs. Talmy (1985) argued that the world's languages could be roughly dichotomized into those emphasizing the path of movement of a figure against a ground or the manner of movement of that figure. For example, Slobin (1996) showed that English speakers tend to choose main verbs that refer to manner of movement and Spanish speakers tend to choose main verbs that highlight the path of movement (Navarro & Nicoladis, 2005). These cross-linguistic patterns can be detected in children's production from as early as three years of age (Allen et al., 2007; Sebastian & Slobin, 1994). In a review of CHILDES transcripts, Hohenstein et al. (2004) showed that English speaking children began to elaborate on manner verbs by including prepositions and satellites in the second half of their third year; prior to this they looked more like the Spanish speaking children with whom their transcripts were compared. Naigles and Terrazas (1998) showed that English- and Spanish-speaking adults had different interpretations of novel motion verbs, with English speakers tending to interpret verbs as referring to manner of motion and Spanish speakers to path of motion. English speaking three-year olds are conservative about generalizing novel verbs over a change in path (Forbes & Farrar, 1993) or manner (Forbes & Farrar, 1995). By the age of seven years, Spanish-speaking children show the adult preference for path interpretation of novel verbs, even when the syntax biases toward a manner interpretation (Hohenstein et al., 2004), whereas English-speaking children were predominantly guided by the syntactic frame presented.

Children show i) confusion in learning extension (across agent, instrument), ii) a preference for source vs. goal in paired perspective verbs, and iii) a tendency to assume that novel verbs refer to path of motion rather than manner. Given these challenges, we propose to test if co-speech gestures can and do help children learn verbs.

Context: Can co-speech gesture offer a helping hand in verb learning?

Co-speech gestures often convey somewhat redundant information with the accompanying speech (McNeill, 1992). Much of the research on gestures to date has focused on how gestures are produced along with speech, showing that gestures often convey information about motion or relations in space and that gestures can differ in form depending on how the spoken language makes reference to motion (Kita & Özyürek, 2003; Özyürek et al., 2008). There is a growing body of research suggesting that children use gestures in the contexts of interpreting speakers' messages and of learning. For example, children have difficulty interpreting messages when a gesture conveys different meaning from the accompanying speech, suggesting that children attempt to incorporate information from both gesture and speech (Church et al., 2000). Valenzano et al. (2003) found that preschool children were better able to learn the concept of symmetry when a teacher's verbal explanation was accompanied by co-speech gesture. Other researchers have found similar effects (Church et al., 2004; McNeil et al., 2000). McGregor et al. (2009) extended these findings specifically to toddlers' learning of the word "under" finding that gestures lead to increased ability to generalize the word to novel situations in comparison to those trained with photographs or in a control condition (see also Booth et al., 2008).

In production, gesture often co-occurs with words that convey motions or relations in space (such as verbs and prepositions) and there is some evidence suggesting that listeners rely on gestures particularly for aid in understanding information about motion and other spatial relations. In adults Kelly et al. (2009) found that pairing co-speech gestures with foreign language verbs helped adults learn those verbs better than without gestures. Furthermore, when co-speech gestures were paired with both nouns and verbs in a foreign language, the gestures helped learners remember the verbs only (Lam, Nicoladis, & Marentette, 2010).

While there is a strong connection between verbs and gestures in the adult literature, much of the literature on gestures in young children has focused on whether gestures can be used as symbolic labels for objects (Namy, 2008; 2009). In our own research, we have questioned the assumption that young children are qualitatively different from adults in how they attend to gestures. First, our research shows that children between 18 and 25 months can fail to learn gestures as labels for objects but can learn gestures as action associates as well as verbs (St. Jean, Nicoladis, & Marentette, in preparation). Second, a longitudinal case study in which a child was taught gestures as object labels daily from 6 months to 2 years 10 months showed that when she learned the meanings of gestures, she did not necessarily extend the meaning of the gesture to a new object of the same kind (Nicoladis, St. Jean, & Marentette, in preparation). This child often extended the meaning of gestures to objects that performed the same action as the trained referent. Third, even older children (between 2 and 5 years) do not fast map gestures as labels for objects, as they do with nouns (Marentette & Nicoladis, in press). Taken together, these results suggest that young children associate gestures with actions.

Does the link between action and gesture indicate that co-speech gesture helps young children learn verbs? Gogate et al. (2000) presented evidence that mothers use multiple modalities when naming actions or objects for their children and that they produce actions, such as movement of the object, in close temporal synchrony with their production of the noun or verb. For nouns this synchrony was highest at very young ages (5-8 months) though for verbs, this tight synchrony extended through the 9-17 month period. In the only study to date that is directly relevant to our proposal, Goodrich and Hudson Kam (2009) demonstrated that the presence of a co-speech gesture enabled preschoolers to learning the meaning of a novel intransitive verb in the absence of other cues.

Building on this body of research, we propose to test how gestures might help disambiguate the meanings of different kinds of verbs for young children. If children are biased to interpret co-speech gestures as actions, then children may use co-speech gestural cues to help infer the meaning of verbs. We hypothesize that children will benefit from the production of co-speech gesture in conjunction with verbs. We first test whether co-speech gestures can help children learn verbs in a series of experimental studies. We predict that co-speech gestures can indeed boost children's short-term learning of novel verbs. We then test whether gestures do actually help children learn verbs in semi-structured observational studies in which parents teach their children novel verbs. We predict that verbs that occur with co-speech gestures are more likely to be learned than those that do not.

We propose two series of studies to address two fundamental questions. In the first three years we plan to address the question: **Can** gestures help? To test whether children *are able* to use co-speech gesture to support verb learning, we propose a series of experimental studies. In the final two years of the proposed project, we will address the question: **Do** gestures help? To test whether children *actually* use co-speech gesture as a reliable cue in typical interactions, we propose a series of observational studies.

Methodology: Experimental studies of the role of gesture in verb learning
Study 1: Can gestures help adults interpret verbs?

The first planned study will use the human simulation paradigm (Gillette et al., 1999) to test whether the presence of co-speech gesture helps adults discern the exact meaning of ten action verbs (such as *hammer, turn, fell*, and *put*) from video whose only auditory cue is a beep in place of the verb. We will create a script so that each verb is embedded in a dialogue with a preschool child. Using an actor and child, we will film the production of this script across four different conditions, with the actor producing each target verb at the same time as 1) a representational gesture, 2) no gesture, 3) a point to the object of the verb or the end location of the verb after the action, and 4) hands thrown up in the air. The last condition is important because simple movement while saying foreign language words made participants think of verbs (Lam et al., 2010). The only auditory cue will be a beep at the production of each verb. After each of the 10 video clips, the participant will be asked to guess the meaning of the verb. We expect to replicate Gillette et al.'s results with conditions 2-4, showing low accuracy rates for guessing the meanings of these verbs. We expect the highest accuracy rate in the representational gesture condition, demonstrating that gestures are a possible contextual cue that can be used by adults to discern the meaning of verbs for actions.

Studies 2a and 2b: Can representational gestures help children tease out verb from agent and object/instrument?

To extend the results of Study 1 to children we will focus on the extension of novel verbs to new agents and instruments. The two proposed studies rely on the same methodology. In the presentation phase, preschool children between 3- and 5-years old see a split screen. On one side, there is a video of a person speaking (and gesturing in the gesture conditions) about the event on the other side of the screen using a novel verb (10 different novel verbs in each study). On the other side, there is a silent video loop of an agent performing some kind of action. Note that listeners typically look at gestures with peripheral vision so they could concentrate on the action depicted and still pick up information about the gesture (Gullberg & Holmqvist, 2006).

In Study 2a, we will test for effects of gesture in children's willingness to extend the meaning of a novel intransitive verb to a novel agent. In the presentation phase, for each of the 10 items, children will hear "Look, the bunny is gliffing! The bunny is gliffing!" Gliffing is a novel intransitive verb about how the rabbit is moving, such as kicking side to side while moving forward. The gestures will mimic the action of the feet of the agent with fingers (Mumford & Kita, 2011). The children will then choose

between the same agent performing a different action (such as a rabbit hopping) or a different agent performing the same action (such as a duck moving forward while kicking side to side).

In Study 2b, the novel verbs presented will be transitive verbs and the gestures will be handling gestures (e.g., spinning a cup). The gestures in the gesture condition would mimic the action the agent was performing. The children would then choose between the same agent performing a different action with the same object (e.g., moving a cup up and down) and the same agent performing the same action with a different object (e.g., spinning a ruler).

Results of these experiments will establish whether co-speech gesture supports children in appropriate generalization, overcoming their predisposition to conservative decision making (Golinkoff & Hirsh-Pasek, 2008).

Study 3: Can gestures help children learn perspective verbs?

The purpose of this study is to test two ways in which gesture might reduce the source bias in children's perspective verb learning: 1) pointing as an attention marker and 2) the viewpoint implied in representational gestures as a cue to transitivity. Representational gestures can highlight either the character viewpoint (C-VPT hereafter), such as mimicking a throwing action to show how a character threw a ball, or the observer viewpoint (O-VPT), such as tracing the path of the ball after it was thrown on a horizontal trajectory in front of one's body. C-VPT gestures are usually produced with transitive sentences while O-VPT gestures are less linked with sentence type (Beattie & Shovelton, 2002). The production of an O-VPT might be enough to push children's interpretation of a perspective verb toward the non-preferred meaning.

In a between-subjects design, 20 children between 3- and 5-years will participate in each of the four conditions in this study. Each child will be presented with 10 items, each item depicting a scene of two actors engaging in some kind of behaviour that could differ by perspective (such as leading/following, chasing/fleeing). Each item will be labelled with a nonsense verb, such as "Look! He's thorping him. He's thorping him", by a person on one side of the split screen. The children will be assigned to one of four conditions: 1) no gesture (just the audio information from the speaker), 2) a point to the goal/experiencer (such as the elephant in the example), 3) representational C-VPT gestures, and 4) representational O-VPT gestures.

We predict that the children will be more likely to pick the non-preferred meaning of the perspective verbs in the pointing condition than in any other condition, replicating Nappa et al. (2009) results about the effectiveness of guiding children's attention. Children in the C-VPT condition should be equally likely to interpret the verb as the non-preferred meaning as in the no-gesture condition (that is, not often) since the C-VPT gestures should highlight transitivity. The children in the O-VPT gesture condition might show a slightly higher rate of choosing the non-preferred meaning than in the C-VPT or in the no-gesture condition, since O-VPT gestures are not strongly linked with a sentence type. The question is whether the O-VPT leads to greater non-preferred than no gesture. This study will establish a degree of influence of co-speech gesture with respect to children's interpretation of verbs in the absence of syntactic cues.

Study 4: Can gestures help children interpret verbs as referring to manner of motion?

Following Naigles and Terrazas (1998), we will present participants with four scenes depicting an agent moving in a particular path. The motion will be labeled with a novel verb. We will present 3-5 year olds with a split screen, with a person labelling the event on one side of the screen and the event depicted on the other side, like a woman skipping toward a tree. The labelling, repeated twice might be "Look! She's kradding". Participants are then asked to choose another instance of "kradding" from the same agent performing a different manner of motion along the same path (e.g., marching toward the tree) or the same agent performing the same manner of motion along a different path (e.g., skipping around the tree).

20 children will be assigned to the no gesture condition, 20 to a path-emphasizing gesture (e.g., an index finger tracing a horizontal path), and 20 to a manner-emphasizing gesture (e.g., the index and middle fingers going up and down in turn, to represent the skipping motion; note that by the age of three years, children can interpret hands used to symbolize feet, Mumford & Kita, 2011). Given that previous studies have thus far shown that preschool English-speaking children have a bias to interpret motion verbs as referring to the path of motion (e.g., Forbes & Farrar, 1995), we predict that there will be no difference between the no-gesture condition and the path-gesture condition. In contrast, children in the manner-gesture condition should pick a higher number of manner-matched scenes.

Graduate students and the post-doctoral fellows will be further expected to design variations that are suggested by the results of the above 4 projects over Years 2-4 of the project.

Methodology: Observational Studies of the role of gesture in verb learning

In Studies 1-4, we predicted that we will show that preschool children can take advantage of co-speech gesture to narrow in on the meaning of verbs in verb-learning experiments. Should the results of these projects demonstrate that children **can** use gestures to support their acquisition of new verbs, we will further need to establish if children **do** use gestures in learning verbs. For this reason, Years 4-5 will focus on testing if children rely on parents' spontaneous gestures in a semi-structured verb-learning task. We stress here that some of the design of this and other observational or elicited use studies will be dependent on what we learn from doing Studies 1-4.

Study 5: Semi-structured verb learning task

We will ask parents to get their preschool children to act out a sentence involving a low-frequency/late-acquired real verb (like "flee" or "borrow" or "gallop"; the specific verbs will be chosen based on the results of Studies 1-4 to reflect aspects of verb learning where gestures are effective). For each child-parent pair, there will be 10 target verbs to learn. Before starting, the children will have a pre-test where they will be asked to choose the meaning of the 10 verbs from a display of four possible pictures. The 10 target verbs will be intermixed with 30 other filler items, including adjectives and high-frequency verbs (such as run and sleep). The children will also be given a standardized vocabulary test such as the Peabody Picture Vocabulary Test (Dunn & Dunn, 2007). We will then ask parents to get their children to act out scenes like "The elephant is fleeing the mouse" without doing or showing the actions to their children. Parents and children will be sitting across a table from each other. There will be a variety of toys on the table, including toy animals and some possible ground-items such as a bridge and a house. The 10 target verbs will be mixed in with 5 other sentences including low-frequency adverbs such as choppily so that parents will be more likely to act naturally. The parent-child interaction will be visually recorded. Children will then be given immediate and delayed (7 day) post-tests. We predict that the more parents use representational gestures to explain the meanings of the target verbs, the more likely children will be to show improvement on the post-tests as to the meaning of the verb.

In addition to these five studies, we have started discussing the possibility of doing a naturalistic observational study of how parents use gestures with their children in spontaneous interactions and how children seem to learn from these interactions. Such as study, if well designed, could reveal important information about the situations in which children use gestures in learning verbs. Implementation of such a study depends upon the results of the other studies outlined in this proposal.

This proposal describes an extensive series of studies designed to ascertain the role of co-speech gesture in overcoming two particular problems of verb learning: 1) temporal asynchrony, and 2) abstraction. Since gestures are primarily produced in temporal synchrony with their accompanying speech and often convey representational information, they are ideal candidates to cue children to verb meaning and help them overcome the established challenges of verb learning. This series of studies will allow us to evaluate this claim and further assess the possibility of using this knowledge effectively in future language development interventions.

References

Allen, S., Ozyurek, A., Kita, S., Brown, A., Furman, R., Ishizuka, T., & Fujii, M. (2007). Language-specific and universal influences in children's syntactic packaging of manner and path: A comparison of English, Japanese, and Turkish. *Cognition, 102*, 16-48.

Baldwin, D. A. (1991). Infants' contribution to the achievement of joint reference. *Child Development, 62*, 875-890.

Beattie, G. & Shovelton, H. (2002). An experimental investigation of some properties of individual iconic gestures that mediate their communicative power. *British Journal of Psychology, 93*, 179-192.

Bélanger, J., & Hall, D. G. (2006). Learning proper names and count nouns: Evidence from 16- and 20-month-olds. *Journal of Cognition and Development, 7*, 45-72.

Bloom, P. (2000). *How children learn the meanings of words*. Cambridge, MA: MIT Press.

Booth, A. E., & Waxman, S. R. (2003). Mapping words to the world in infancy: Infants' expectations for count nouns and adjectives. *Journal of Cognition and Development, 4*, 357-381.

Booth, A. E., McGregor, K. K., & Rohlfing, K. J. (2008). Socio-pragmatics and attention: Contributions to gesturally guided word learning in toddlers. *Language Learning and Development, 4*, 179-202.

Bornstein, M. H., Cote, L. R., Maital, S., Painter, K., Park, S., Pascual, L., et al. (2004). Cross-linguistic analysis of vocabulary in young children: Spanish, Dutch, French, Hebrew, Italian, Korean, and American English. *Child Development, 75*, 1115-1139.

Chan, W. H. & Nicoladis, E. (2010). Predicting two Mandarin-English bilingual children's first 50 words: Effects of frequency and relative exposure in the input. *International Journal of Bilingualism, 14*, 1-34.

Childers, J.B., & Tomasello, M. (2006). Are nouns easier to learn than verbs? Three experimental studies. In K. Hirsch-Pasek & R. M. Golinkoff (Eds.), *Action meets word: How children learn verbs* (pp. 311-335). Oxford: Oxford University Press.

Childers, J. B. (2011). Attention to multiple events helps two-and-a-half-year-olds extend new verbs. *First Language, 31*, 3-22.

Church, R. B., AymanNolley, S., & Mahootian, S. (2004). The role of gesture in bilingual education: Does gesture enhance learning? *International Journal of Bilingual Education and Bilingualism, 7*, 303-319.

Church, R. B., Kelly, S. D., & Lynch, K. (2000). Immediate memory for mismatched speech and representational gesture across development. *Journal of Nonverbal Behavior, 24*, 151-174.

Diesendruck, G., Hall, G., & Graham, S. (2006). Children's use of syntactic and pragmatic knowledge in the interpretation of novel adjectives. *Child Development, 77*, 16-30.

Dunn, L. M. & Dunn, D. M (2007). Peabody Picture Vocabulary Test, Fourth Edition. Circle Pines, MN: American Guidance Service.

Fisher, C., Hall, D. G., Rakowitz, S., & Gleitman, L. (1994). When it is better to receive than to give: Syntactic and conceptual constraints on vocabulary growth. *Lingua, 92*, 333-375.

Forbes, J. N. & Farrar, M. J. (1995). Learning to represent word meaning: What initial training events reveal about children's developing action verb concepts. *Cognitive Development, 10*, 1-20.

Forbes, J. N. & Farrar, M. J. (1993). Children's initial assumptions about the meaning of novel motion verbs: Biased and conservative? *Cognitive Development, 8*, 273-290.

Gentner, D. (1982). Why nouns are learned before verbs: Linguistic relativity versus natural partitioning. In S. A. Kuczaj (Ed.), *Language Development: Vol. 2. Language, thought, and culture* (pp. 301-334). Hillsdale, NJ: Lawrence Erlbaum.

Gentner, D. (2006). Why verbs are hard to learn. In K. Hirsch-Pasek & R. M. Golinkoff (Eds.), *Action meets word: How children learn verbs* (pp. 544-564). Oxford: Oxford University Press.

Gillette, J., Gleitman, H., Gleitman, L., & Lederer, A. (1999). Human simulations of vocabulary learning. *Cognition, 73*, 135-176.

Gleitman, L., Cassidy, K., Nappa, R., Papafragou, A., & Trueswell, J. C. (2005). Hard words. *Language Learning and Development, 1*, 23-64.

Gogate, L. J., Bahrick, L. E., & Watson, J. D. (2000). A study of multi-modal motherese: The role of temporal synchrony between verbal labels and gestures. *Child Development, 71*, 878-894.

Goldin-Meadow, S., & Beilock, S. L. (2010). Action's influence on thought: The case of gesture. *Perspectives on Psychological Science, 5*, 664-674.

Golinkoff, R. M. Jacquet, R. C., Hirsh-Pasek, K., & Nandakumar, R. (1996). Lexical principles may underlie the learning of verbs. *Child Development, 67*, 3101-3119.

Golinkoff, R. M., & Hirsh-Pasek, K. (2008). How toddlers begin to learn verbs. *Trends in Cognitive Sciences, 12*, 397-403.

Goodrich, W., & Hudson Kam, C. L. (2009). Co-speech gesture as input in verb learning. *Developmental Science, 12*, 81– 87.

Graziano, M., Nicoladis, E., & Marentette, P. (submitted). What the timing of gestures relative to speech reveals about speaker's rhetorical strategies. *Journal of Pragmatics*.

Gullberg, M. & Holmqvist, K. (2006). What speakers do and what addressees look at: Visual attention to gestures in human interaction live and on video. *Pragmatics and Cognition, 14*, 53-82.

Hohenstein, J. M., Naigles, L. R., & Eisenberg, A. R. (2004). Keeping verb acquisition in motion: A comparison of English and Spanish. In D. G. Hall & S. R. Waxman (Eds.), Weaving a lexicon (pp. 569-602). Cambridge, MA: MIT Press.

Imai, M., Haryu, E., & Okada, H. (2005). Mapping novel nouns and verbs onto dynamic action events: Are verb meanings easier to learn than noun meanings for Japanese children? *Child Development, 76*, 340-355.

Imai, M., Li, L., Haryu, E., Okada, H., HirshPasek, K., Golinkoff, R. M., & Shigematsu, J. (2008). Novel noun and verb learning in Chinese-, English-, and Japanese-speaking children. *Child Development, 79*, 979-1000.

Kauschke, C., Lee, H., & Pae, S. (2007). Similarities and variation in noun and verb acquisition: A crosslinguistic study of children learning German, Korean, and Turkish. *Language and Cognitive Processes, 22*, 1045-1072.

Kelly, S. D., McDevitt, T., & Esch, M. (2009). Brief training with co-speech gesture lends a hand to word learning in a foreign language. *Language and Cognitive Processing, 24*, 313-334.

Kersten, A. W., & Smith, L. B. (2002). Attention to novel objects during verb learning. Child Development, 73, 93-109.

Kita, S. (2000). How representational gestures help speaking. In D. McNeill (Ed.), Language and gesture (pp. 162–185). Cambridge: Cambridge UniversityPress.

Kita, S., & Ozyurek, A. (2003). What does cross-linguistic variation in semantic coordination of speech and gesture reveal?: Evidence for an interface representation of spatial thinking and speaking. *Journal of Memory and Language, 48*, 16-32.

Krauss, R. (1998). Why do we gesture when we speak? *Current Directions in Psychological Science, 7*, 54-60.

Lam, C., Nicoladis, E., & Marentette, P. (July, 2010). Seeing co-speech gestures with Cantonese words makes people think of verbs. Poster presented at the 4th Conference of the International Society for Gesture Studies. Frankfurt/Oder, Germany.

Laurent, A., Nicoladis, E., & Marentette, P. (submitted). The development of storytelling in two languages with words and gestures. *International Journal of Bilingualism*

Maguire, M. J., Hirsh-Pasek, K., Golinkoff, R. M., & Brandone, A. C. (2008). Focusing on the relation: Fewer exemplars facilitate children's initial verb learning and extension. *Developmental Science, 11*, 628-634.

Marentette, P. & Nicoladis, E. (in press). Preschoolers' interpretations of gesture: Label or action associate? *Cognition*, doi:10.1016/j.cognition.2011.08.012

Marentette, P. & Nicoladis, E. (2008). Iconicity and simultaneity in the gesture-language link: A comparison of ASL signers and English speakers. Paper presented at the Deutsche Gesellschaft fur Sprachwissenshaft (DGfS) Workshop: Gesture: A comparison of signed and spoken languages. Bamberg, Germany, Feb 27-29.

McDonough, C., Song, L., Hirsh-Pasek, K., Golinkoff, R. M., & Lannon, R. (2011). An image is worth a thousand words: Why nouns tend to dominate verbs in early word learning. *Developmental Science, 14*, 181-189.

McGregor, K. K., Rohlfing, K. J., Bean, A., & Marschner, E. (2009). Gesture as a support for word learning: The case of under. *Journal of Child Language, 36*, 807-828.

McNeil, N. M., Alibali, M. W., & Evans, J. L. (2000). The role of gesture in children's comprehension of spoken language: Now they need it, now they don't. Journal of Nonverbal Behavior, 24, 131-150.

McNeill, D. (1992). *Hand and mind: What gestures reveal about thought*. Chicago: Chicago University Press.

Moroschan, G. & Nicoladis, E. (submitted). Children treat adjectives and nouns as modifiers in prenominal position differently. *First Language*.

Mumford, K. & Kita, S. (2011) Helping hands: Recognising iconicity in gestures and its advantage during verb acquisition. Poster presented at the International Association for Studies in Child Language, Montreal, July.

Naigles, L. (1990). Children's use of syntax to learn verb meanings. *Journal of Child Language, 17*, 357-374.

Naigles, L. R. & Hoff-Ginsberg, E. (1998). Why are some verbs learned before other verbs? Effects of input frequency and structure on children's early verb use. *Journal of Child Language, 25*, 95-120.

Naigles, L. R. & Terrazas, P. (1998). Motion-verb generalizations in English and Spanish: Influences of language and syntax. *Psychological Science, 9*, 363-369.

Namy, L. (2008). Recognition of iconicity doesn't come for free. *Developmental Science, 11*, 841-846.

Namy, L. L. (2009). Early word learning and other seemingly symbolic behaviors. In A. Woodward & A. Needham (Eds.), *Learning and the infant mind* (pp. 249–262). Oxford: OUP.

Namy, L. L., Campbell, A. L., & Tomasello, M. (2004). The changing role of iconicity in non-verbal symbol learning: A U-shaped trajectory in the acquisition of arbitrary gestures. *Journal of Cognition and Development, 5*, 37–57.

Nappa, R., Wessel, A., McEldoon, K. L., Gleitman, L. R., & Trueswell, J. C. (2009). Use of speaker's gaze and syntax in verb learning. *Language Learning and Development, 5*, 203-234.

Navarro, S. & Nicoladis, E. (2005). Describing motion events in adult L2 Spanish narratives. In D. Eddington (Ed.), *Selected Proceedings of the 6th Conference on the Acquisition of Spanish and Portuguese as First and Second Languages* (pp. 102-107). Somerville, MA: Cascadilla Proceedings Project. www.lingref.com, document #1129

Nicoladis, E., Palmer, A. & Marentette, P. (2007). The role of type and token frequency in using past tense morphemes correctly. *Developmental Science, 10,* 237-254.

Nicoladis, E., Pika, S., & Marentette, P. (2010). Are number gestures easier than words for preschoolers? *Cognitive Development, 25,* 247-261.

Nicoladis, E., Pika, S, & Marentette, P. (2009). Do French-English bilingual children gesture more than monolingual children? *Journal of Psycholinguistic Research, 38*, 573-585.

Nicoladis, E., Song, J., & Marentette, P. (in press). Do young bilinguals acquire past tense morphology like monolinguals, only later? Evidence from French-English and Chinese-English bilinguals. *Applied Psycholinguistics*.

Nicoladis, E., St. Jean, J., & Marentette, P. (in preparation). A longitudinal case study of the acquisition of symbolic gestures as object labels. Unpublished manuscript.s

Ozyurek, A., Kita, S., Allen, S., Brown, A., Furman, R., & Ishizuka, T. (2008). Development of cross-linguistic variation in speech and gesture: Motion events in English and Turkish. Developmental Psychology, 44(4), 1040-1054.

Pika, S., Nicoladis, E., & Marentette, P. (2006). A cross-cultural study on the use of gestures: Evidence for cross-linguistic transfer? *Bilingualism: Language and Cognition, 9*(3), 319-327.

Quine, W. V. (1964). *Word and object*. Oxford: MIT Press.

Sebastián, E. & Slobin, D. I. (1994). Development of linguistic forms: Spanish. In R. A. Berman and D. I. Slobin (Eds.), *Relating events in narrative: A cross-linguistic developmental study* (pp. 239-284). Hillsdale, NJ: Erlbaum.

Slobin, D. I. (1996). Two ways to travel: Verbs of motion in English and Spanish. In M. Shibitani & S. Thompson (Eds.), *Grammatical constructions: Their form and meaning* (pp. 195-219). Oxford: Oxford University Press.

Snedeker, J. & Trueswell, J. C. (2004). The developing constraints on parsing decisions: The role of lexical-biases and referential scenes in child and adult sentence processing. *Cognitive Psychology, 49*, 238-299.

St. Jean, J., Nicoladis, E., & Marentette, P. (in preparation). Infants learn words better than symbolic gestures as object labels. Unpublished manuscript.

Talmy, L. (1985). Lexicalization patterns: Semantic structure in lexical forms. In T. Shopen (Ed.), *Language typology and syntactic description: Vol. III. Grammatical categories and the lexicon* (pp. 57–149). Cambridge: Cambridge University Press.

Tardif, T., Gelman, S. A., & Xu, F. (2009). Putting the noun bias in context: A comparison of English and Mandarin. *Child Development, 70*, 620-635.

Tomasello, M. (2000). The item-based nature of children's early syntactic development. *Trends in Cognitive Sciences, 4*, 156-163.

Valenzeno, L., Alibali, M. W., & Klatzky, R. (2003). Teachers' gestures facilitate students' learning: A lesson in symmetry. *Contemporary Educational Psychology, 28*, 187-204.

Veneziano, E. & Parisse, C. (July, 2011). Retrieving the meaning of words from syntactic cues: A comprehension study of 2 to 4 yrs [sic] old French-speaking children. Poster presented at the International Association for the Study of Child Language. Montreal, Quebec, Canada.

The knowledge mobilization plan for the proposed project focusses on effective communication of research results to fellow scholars across a range of disciplines, including the organization of a conference. Pending outcomes of the project, we also plan to communicate research results with appropriate groups of parents and clinicians.

Publications
We are committed to publication of research results and the past publication record of the research team supports this claim. We have co-authored most of our peer-reviewed papers with postdoctoral fellows and graduates students. One goal of this grant is to increase the number of articles with undergraduate co-authors. We plan to publish in both specialist (*Applied Psycholinguistics, Journal of Child Language*) and more general (*Psychological Science, Developmental Science*) periodicals.

Conferences
Conference attendance is our primary method of communicating work in progress with international researchers. Through conference attendance we receive efficient and nuanced feedback as well as developing a network of potential colleagues for future collaboration, and sources for graduate students and postdoctoral fellows. Our plan is to target the following conferences as they provide an international and cross-disciplinary mix of specialist and generalist conferences. These are only the currently planned events, we anticipate that other workshops and topic-specific conferences will be announced over the course of the project.
- Boston University Conference on Language Development, November 2014, 2016
- American Speech-Language-Hearing Association, annually in November, 2015, 2017
- Association for Psychological Science, annually in May, Washington, DC, 2013, 2015, 2017
- American Association for the Advancement of Science: annually in February, Chicago, 2014, San José, 2015, tbd 2017
- International Society for Gesture Studies, biennial: tbd 2014, 2016
- International Association for the Study of Child Language, Amsterdam 2014, tbd 2017

We also propose to host and organize the International Society for Gesture Studies conference in Alberta, likely in 2016. To support this application, we will apply for SSHRC Aid to Research Workshops and Conferences and the University of Alberta's internal funding for conferences.

Community Connections
We will connect with community clinicians and interested parent groups (e.g., *Parent Link*, *Success by 6 Edmonton*) to assess relevance and interest in research summaries or community workshops. We will design a web page with information about how our research has applications to children's language learning.

Data Archiving and Accessibility
We fully support open access to published work. Most publishers permit final version but not typeset copies of accepted articles to be published on an author's personal webpage. Some publishers (i.e., Elsevier) a) support free access to databases of journals by researchers in developing countries, b) license walk-in user access at research libraries, and c) support document archives with highly functional platforms for effective search and retrieval. These initiatives fulfill the obligations of publicly funded research to be widely accessible, while maintaining the quality control of peer review. Where ethics guidelines and copyright permit, we will use the UofA's Education and Research Archive (https://era.library.ualberta.ca/public/home) as a repository for articles. Data will be deposited following SSHRC's suggested timelines.

Family name, Given name
Nicoladis, Elena

Intended Outcomes of Proposed Activities
Elaborate on the potential benefits and/or outcomes of your proposed research and/or related activities.

Scholarly Benefits
Indicate and rank up to 3 scholarly benefits relevant to your proposal.

Rank	Benefit	If "Other", specify
1	Knowledge creation/intellectual outcomes	
2	Student training/skill development	
3	Enhanced research methods	

Social Benefits
Indicate and rank up to 3 social benefits relevant to your proposal.

Rank	Benefit	If "Other", specify
1	Social outcomes	
2	Training and skill development	
3	Behavioural outcomes	

Audiences
Indicate and rank up to 5 potential target audiences relevant to your proposal.

Rank	Audience	If "Other", specify
1	Academic sector/peers, including scholarly associations	
2	Professional and/or scholarly associations	
3	International audiences	
4	Practitioners/professional associations	
5		

Application WEB

PROTECTED B WHEN COMPLETED

Family name, Given name

Nicoladis, Elena

Expected Outcomes Summary

Describe the potential benefits/outcomes (e.g., evolution, effects, potential learning, implications) that could emerge from the proposed research and/or other partnership activities.

We expect the primary contributions of the proposed research project will be in the form of intellectual advancement and the training of highly qualified personnel. There are indirect social benefits of this research and the potential for direct social benefits depending upon the results obtained.

We have proposed a systematic project to address a specific gap in children's acquisition of verbs. Although many social and pragmatic factors supporting semantic and syntactic drivers of verb development have been examined, there are to date few articles that evaluate the potential role of co-speech gesture as a tool that enables children to quickly master verbs. There is general agreement that verbs are challenging. The proposed project will make important evidential and methodological advances by clarifying the contributions of gesture to this aspect of language development. Although it will not be funded by this grant, our research team will apply to the International Society for Gesture Studies to host their biennial conference in Alberta, likely in 2016. Hosting such a conference will enable the research team to support international communication in this growing interdisciplinary research field.

The proposed 5-year research plan involves the implementation of many different experimental and observational protocols and provides abundant training opportunities. This project require coordination at a high level, demanding the services of 2 postdoctoral fellows over its course. In turn, the actual research design and data analyses for some parts of the project will be the focus of at least one graduate student funded directly by the project, and potentially other graduate students in the department. If successful we will also fund at least 15 undergraduate research assistants who will contribute to data collection and analysis.

Social benefits from this research project cover two areas: one anticipated and one potential. We anticipate that parents will be interested in the role of co-speech gesture in language development in general. Parents are generally interested in child development and particularly language development. There is a marked degree of interest in baby sign, though parents are often uncertain about what feels like a significant undertaking to learn "sign". We expect that parents might be very interested in learning about language development and the holistic environment that supports it, including co-speech gesture. Depending on our results, our research may benefit children who are experiencing delayed language development. Our experimental studies may uncover particular methodologies using co-speech gesture to support the effective learning of verbs. If so, these outcomes will be of interest to clinicians.

We anticipate that our primary audience will be academics working in the area of linguistics, psycholinguistics, and cognitive development. Our results will also interest clinicians in speech and language pathology, early childhood education, and other more applied areas of scholarship. We anticipate that there will be a more general audience for this work among engaged parents and teachers of young children.

Personal information will be stored in the Personal Information Bank for the appropriate program.

Application WEB

Page 8

PROTECTED B WHEN COMPLETED

Research Team, Previous Output and Student Training
A. Description of the research team

Thanks to previous SSHRC funding, Elena Nicoladis and Paula Marentette have been collaborating for the past ten years. Our expertise in child language has given us a specific perspective on the role of gesture in children's cognitive development. We work together closely and each brings a complementary part, both in terms of style and knowledge, to the research we do. We share backgrounds in language and gesture use and development. Elena Nicoladis further specializes in lexical and morphological development research. Paula Marentette has expertise in sign language acquisition. A team approach is beneficial for us in at least three ways: we design experiments together, we challenge each other theoretically, and we keep each other focussed on our key questions. Collectively these benefits result in a higher quality and quantity of work.

We propose to conduct research on verb learning, a topic that relies on expertise built on our previous research. We have published papers on acquisition of past tense (Nicoladis et al., 2007; in press) and on other areas of lexical and morphological development (e.g., Chan & Nicoladis, 2010). A robust team is required to conduct this extensive project. We propose to invite one postdoctoral fellow (Years 2 and 3) who is familiar with the literature and the methodologies used in the acquisition of verbs, ideally in the context of running experimental studies with children. This person would bring specific skills but would also benefit from our experience in gesture research. Later in the project, another postdoctoral fellow would contribute to observational studies on language acquisition to support planned research addressing questions about whether gestures do, in fact, help children learn verbs (Years 4 and 5). While maintaining responsibility for the direction of the overall project and the supervision of all members of the project team, we enable postdoctoral fellows to have as broad a range of experiences as possible. To that end, the post-doctoral fellows would be expected to supporting the training of both graduate and undergraduate students as well as to design and implement studies. We expect all team members, Elena Nicoladis, Paula Marentette, and the new post-doctoral fellows, to contribute equally to the ongoing research program, including supervision of students.

Elena Nicoladis currently holds a Discovery grant from NSERC. In the past, she has divided her research time approximately equally across projects related to the two grants. Paula Marentette will devote 80% of her research time to this proposed project. She is otherwise involved in a collaborative cross-linguistic project (with Italian and British researchers) on elicited gesture in two-year olds.

B. Description of previous and ongoing research results

We have received three previous SSHRC grants. With the first SSHRC grant, we collected data from speakers of a number of different backgrounds and a number of different ages watching a Pink Panther cartoon and telling back the story. The groups included: English monolinguals, ASL monolinguals, English-ASL bilinguals, French monolinguals, English-French bilinguals, Spanish monolinguals, English-Spanish bilinguals, Mandarin monolinguals, English-Mandarin bilinguals, and English-Hindi bilinguals. Within most of those groups, we have data across a range of ages, from preschool to late adulthood. These data led to a number of publications and conference presentations. Among other findings, we have shown that bilinguals gesture more than monolinguals (Nicoladis et al., 2009 with preschoolers; Pika et al., 2006 with adults) and that signers stop signing to perform highly embodied gestures (Marentette & Nicoladis, 2008). As we now have a database of stories told by a lot of speakers from different ages and different language backgrounds, we are still using the database to ask other questions about narratives, including how oral story-telling develops (Laurent et al., submitted).

With our second SSHRC grant, we collected data in a series of studies designed to test children's sensitivity to iconicity (that is, the physical resemblance between gesture and referent). We argued that children initially assume that symbols are arbitrarily linked to their referent and would only take advantage of the iconicity available in gestures after they had learned many symbols (particularly words). We carried out a number of studies to test this hypothesis. In one study, we asked preschool

children to produce and interpret number gestures and number words. Number words are arbitrarily related to quantities (e.g., there is nothing about the word *three* that indicates threeness) while there is a one-to-one correspondence for number gestures between the number of fingers held up and the quantity. We found that the preschool children were more accurate at producing and interpreting number words than number gestures (Nicoladis et al., 2010). Children learn number gestures as arbitrary symbols and so there is no advantage to number gestures over words in acquisition. In anecdotal support of this argument, one child, when asked to produce the number eight with his hands, produced a gesture that looked like the written number eight.

In a follow-up study, we asked preschoolers to interpret unconventional number gestures (such as the thumb and index finger to indicate 'two'; this gesture is conventionally 'two' in many parts of Europe, but not in Canada). The children often interpreted the gesture as the closest conventional gesture (e.g., assumed it was the Canadian gesture for 'one', ignoring the thumb). While we showed that preschool children had difficulty interpreting unconventional gestures, we know that school-aged children can calculate using their fingers. We reasoned that the change in age could be due to a change in selective attention abilities. Bilinguals have sometimes been shown to have higher selective attention abilities than monolinguals. To test this possibility, we compared preschool monolinguals and bilinguals on their interpretation of unconventional number gestures. We showed that, indeed, German-English bilinguals and French-English bilinguals were better at using the one-to-one correspondence in unconventional number gestures than English monolinguals, for small quantities. We think that the bilingual advantage is limited by working memory capacities of preschool children (typically around 2-3 chunks). We are currently designing another study in which we will directly test selective attention.

We also collected data from preschool children in which we tested whether they could fast-map novel arbitrary/iconic gestures to objects equally as well as novel nouns. We found that children tended to assume that novel nouns referred to an object for which they did not already have a label, replicating many previous studies. In contrast, children tended to assume that iconic gestures referred to an object that performed the same action as the gesture, even if they already had a label for that object. Furthermore, children resisted using an arbitrary gesture as a label for a novel object (Marentette & Nicoladis, in press). These results suggest that children interpret gestures as action associates, that is, they assume that gestures refer specifically to what you can do with an object.

We have found supporting evidence for this interpretation in another study with younger children, using different methodology. This study was designed to address the issue as to whether children take advantage of the iconicity in gestures by teaching them novel gestures which are either iconically or arbitrarily related to the referent. We did one study with this design with 18-24 month old children find it easier to learn gestures that are arbitrarily or iconically related to the referent. The children in that study were better at learning novel nouns as labels for objects than either iconic or arbitrary gesture. In that study, we noticed that the one gesture the children learned better than others was the gesture that mimicked the action one performed in playing with the toy. The results from the pilot study for this study were presented at the International Association for Studies of Child Language in Montreal in July 2011. We are currently testing whether children can learn iconic/arbitrary gestures meaning actions better than novel verbs. The initial results suggested that the children could learn iconic gestures better than verbs and were, in turn, better at verbs than with arbitrary gestures.

The third SSHRC grant focused on the timing of gestures relative to similar-meaning speech. With post-doctoral fellow, Dr. Maria Graziano, we have completed one project related to this focus and are still in the piloting stage of two other projects. Graziano et al. (in revision) compared the number of synchronous and asynchronous gestures in monolingual and bilingual adults telling a story. Synchrony (or asynchrony) was operationalized as simultaneous production of gesture and similar-meaning speech. We showed that there was no difference on the frequency of asynchronous gestures in bilinguals and monolinguals, in spite of previously reported groups differences in lexical access difficulties. This finding is suggestive that asynchrony in gesture production may not be strongly related to difficulty with

lexical access (contra Krauss, 1998). Furthermore, we found that most asynchronous gestures preceded the similar-meaning speech, rather than followed. This finding is in line with speculation that gestures play an important role in the conceptual planning of what to say (Kita, 2000). Finally, a qualitative analysis showed that speakers tend to use asynchrony to focus listeners' attention to the impact of what they are saying. Taken together, these results suggest that adults may use asynchrony as a discourse strategy to add nuance to how listeners should interpret their message. The two studies we are currently piloting involve 1) looking at how children use asynchrony in gesture-speech over the course of narrative development and 2) looking at different discourse types (e.g., giving directions, telling autobiographical stories, giving a lecture) to see how gesture differs across types and whether asynchrony is more likely used as a tool in specific contexts.

Elena Nicoladis is also involved in NSERC-funded research focused on children's acquisition of word order and bilingual children's cross-linguistic transfer. This research is revealing that children attend to word order only when the order makes a difference in meaning. For example, in one study, we taught children novel adjectives (e.g., *groffish*) and novel nouns-used-as-modifiers (e.g., *dax*, used to describe a box full of *daxes*). We tried to use these novel words after modified nouns (e.g., *a cow groffish* and *a box dax*). The children were more likely to correct the order of adjective-noun constructions than noun-noun constructions. We think this result is due to the fact that misordering an adjective-noun construction (e.g., *a car black*) sounds odd but doesn't change the meaning of the construction as a whole. In contrast, the order of noun-noun constructions (e.g., compare *a factory door* and *a door factory*) necessarily changes the meaning (Moroschan & Nicoladis, submitted). The data currently being collected in this line of research involve bilingual children's ordering of both compounds and adjective-noun constructions (e.g., will the French-English bilingual children who are more likely to say "a car yellow" in English also more like to say "a car-pickle" to refer to a car in the shape of a pickle?) and production of past tense forms of novel verbs.

C. Description of proposed student training strategies

Undergraduate and graduate students at the University of Alberta are trained in research through an apprenticeship model. This research project will provide students with hands-on research experience. At the undergraduate level, we will lead students through all stages of experimentation, from forming a hypothesis to interpreting results. This type of experience is critical for expanding students' awareness of and preparation for the opportunities that exist in postgraduate studies. At the graduate level, in the early stages of their training, we expect them to take on studies that we have designed (such as the ones described in this proposal) and carry them out. After they have done that, we expect them to design studies on their own that test either the present hypotheses and/or hypotheses that have emerged from the carrying out of previous research, still with our supervision. At the same time, they will help supervise undergraduate honours students and research assistants.

Because this approach is our modus operandi, we stress that the studies that we have proposed are only the starting point for our next phase of research. We expect that the subsequent studies will be highly influenced if not outright designed by students as they gain experience in research.

Undergraduate students take on a small and well-defined part of planned studies. Students who have finished their third year of courses in developmental psychology, psycholinguistics, and research methods with a strong GPA will be eligible for the positions. We try to match up the part of the study that they do with their interests and goals. For example, students who have experience working with children often focus more on data collection. Students who intend to go on to graduate work might focus more on writing up results. The research experience allows them to judge whether research is of interest to them and if they would like to further their careers in research. If they do not, they still have learned a vital part of how scientific research takes place and have furthered their critical thinking abilities.

Graduate students take on larger part in studies and help in the supervision of undergraduate students. As in the past, any work produced by students that is published or presented at conferences will be

acknowledged, either through course credit or authorship, as appropriate. We have worked with graduate students Jaya Nagpal, Hui Yin, and Jianhui Song, all of whom are authors on publications. Some undergraduate students, including Wai Han Chan, Mijke Rhemtulla, and Kristan Marchak, have also helped author previous publications. Both Mijke Rhemtulla and Kristan Marchak went on to do related graduate work.

       We have worked with two post-doctoral fellows, Dr. Simone Pika (currently the head of a research group Comparative Gestural Signalling at the Max Planck Institute for Ornithology in Germany) and Dr. Maria Graziano (currently a postdoctoral fellow working on gestures in bilinguals at Lund University in Sweden). Both were funded by previous SSHRC grants. We continue to collaborate with both Drs. Pika and Graziano.

Family name, Given name
Nicoladis, Elena

Funds Requested from SSHRC

For each budget year, estimate as accurately as possible the research costs that you are asking SSHRC to fund through a grant. For each Personnel costs category, enter the number of individuals to be hired and specify the total amount required. For each of the other categories, enter the total amount required.

Personnel costs	Year 1 No.	Year 1 Amount	Year 2 No.	Year 2 Amount	Year 3 No.	Year 3 Amount	Year 4 No.	Year 4 Amount	Year 5 No.	Year 5 Amount
Student salaries and benefits/Stipends										
Undergraduate	3	15,600	3	16,224	3	16,896	3	17,568	3	18,240
Masters	1	17,500	1	18,000	0	0	0	0	0	0
Doctorate	0	0	0	0	1	22,000	1	22,000	1	22,000
Non-student salaries and benefits/Stipends										
Postdoctoral	0	0	1	46,000	1	48,000	1	47,000	1	49,000
Other	1	2,000	1	1,000	1	1,000	1	1,000	1	1,000
Travel and subsistence costs	Year 1		Year 2		Year 3		Year 4		Year 5	
Applicant/Team member(s)										
Canadian travel										
Foreign travel	2,800		10,000		11,600		10,000		11,600	
Students										
Canadian travel										
Foreign travel	1,600		4,400		2,800		1,600		2,800	
Other expenses										
Professional/Technical services										
Supplies										
Non-disposable equipment										
Computer hardware	5,660		1,785		1,785		3,600		0	
Other	500		0		0		0		0	
Other expenses (specify)										
Photocopies	500		500		500		500		500	
Software (licenses)	480		530		530		530		530	
PPVT-IV	1,200		0		0		0		0	
Total	47,840		98,439		105,111		103,798		105,670	

Application WEB

PROTECTED B WHEN COMPLETED

Budget Justification
Personnel costs

We have budgeted for three undergraduate research assistants per year. These research assistants will be charged with the day-to-day tasks, such as photocopying, recruiting and testing children, helping with literature reviews. Note that we have included several undergraduate research assistants on publications as authors in the past (see Research Team), if they contributed creatively and/or substantially to the study. We hope to continue encouraging undergraduates to publish in our lab. Each year we have budgeted for two students to work 10 hours/week during the fall and winter terms and one student to work full-time (35 hours) during the 16-week summer. During year 1, we assumed $16.25/hour and 16% for benefits ($15,600). During year 2, we assumed $16.90/hour + 16% for benefits ($16,224). For year 3, we assumed $17.60/hour + 16% for benefits ($16,896). For year 4, we assumed $18.30/hour + 16% for benefits ($17,568). For year 5, we assumed $19/hour + 16% for benefits ($18,240). The assumption of a 10% increase per year follows the current practice in the Faculty of Arts at the University of Alberta.

We also budgeted for a single graduate student, the first year at $17500 and the second year at $18000 for this student's master's program (the current level of psychology department support at the University of Alberta is $17500) and $22000 for the student's PhD program (the current level of psychology department support is $20000). Being able to commit to five years of support increases our ability to attract a suitable graduate student. The graduate student will be tasked with taking charge of Study 1 as his/her First Year Research Project. Following that, he/she will be expected to devise his/her own studies in conjunction with us, following a similar theme.

We have budgeted for two post-doctoral fellows, each at a two-year tenure. We have budgeted $46000 for the first post-doc's first year and $48000 for the following year. The first post-doc (Years 2 and 3) will have experience in running language experiments with children. Ideally, this will be someone who can deal with the technological issues behind a split-screen video presentation we have designed. This post-doc will take on the primary responsibility of designing and supervising students to help run the studies designed at testing whether children can use gestures as a cue to verb learning. The second post-doc (Years 4 and 5) will have experience with observational or semi-structured designs. Collecting observational data is time-consuming and requires a great deal of organization, so this experience is essential. This post-doc will take on the primary responsibility of designing and supervising students to help run the studies designed at testing whether children do use gestures as a cue to verb learning. We have budgeted $47000 for this post-doc's first year and $49000 for the second year.

We have budgeted $2000 to pay an expert in web design and maintenance to design a website that makes our research open and accessible to both research communities and the general public. Every year thereafter, we have budged for $1000 per year to maintain that website and archive any possible publications.

Travel and subsistence costs

All the travel we have budgeted is for communication purposes. For every trip to Europe, we have budgeted $2800 (estimated on $1500 round trip airfare, $600 hotel, $500 registration and $200 living expenses). For every trip to the United States, we have budgeted $1600 (estimated on $800 round trip airfare, $500 hotel, $200 registration and $100 living expenses).
Y1: **PI and CI**: one trip to Europe to communicate about our initial findings at an international conference. **Graduate student**: one American conference.
Y2: **PI & CI**: between us two European and one American conference for dissemination. **Graduate students**: one American, one European conference. **Postdoctoral fellow**: one American conference.
Y3:**PI & CI**: between us two European and one American conference for dissemination. . **Graduate student**: one European conference. **Postdoctoral fellow**: one American and one European conference.
Y4: **PI & CI**: between us two European and one American conference for dissemination. **Graduate**

student: one American conference. **Postdoctoral fellow**: one American conference.
Y5:**PI & CI**: between us two European and one American conference for dissemination. **Graduate student**: one European conference. **Postdoctoral fellow**: one American and one European conference. The necessity of these trips is outlined in the Knowledge Mobilization strategy.
We include money for conference travel for current graduate student, Lisa Smithson in Years 1 & 2. Lisa is working on related projects in terms of how children's gesture use is related to visuo-spatial working memory and imagery.

Other expenses

The two computers currently in our lab were purchased in 2001 and cannot run Flash or many other current versions of software. These are the computers on which the experiments will be run so these need to be up-to-date. In Year 1, we have budgeted for two 27" 3.1 Ghz i5 Apple computers ($1899 + 2% GST = $1937 each). We have also budgeted for a total of five portable computers (15" 2.0Ghz i7 Apples, currently listed at $1749 + 2% GST = $1785; from Year 4 on, the price was estimated at $1800 to take inflation into account). One portable computer is for the graduate student (Year 1), one is for each post-doc (so years 2 and 4) and one is for the PI and CI.

We have budgeted for two external hard drives that allow encryption and back-up of our data. We based the estimate on the price of a 2.0TB Imation external hard drive, currently $218.54.

We have budgeted for software licenses: Adobe Acrobat Pro (to allow for efficient document management; the initial license is $105 and $75 for each additional person; we have budgeted for one person) and SPSS (a statistical package we have been using; the license runs approximately $125/year and we have budgeted for 3 licenses for the first year for the graduate student, the PI and the CI; in the following years, we have budgeted for the post-doc as well, so four licenses in total).

We have estimated our photocopying cost at approximately $500/year, which includes photocopying consent forms and scanning proofread manuscripts for copy-editing.

We have estimated $1200 for buying the Peabody Picture Vocabulary Test, version IV (we own version III-R). The price for Forms A and B with software quoted on Pearson Canada is $993 without GST and shipping so we rounded to $1200 to include GST and shipping.

Funds from Other Sources

You must include all other sources of funding for the proposed research. Indicate whether these funds have been confirmed or not. Where applicable, include (a) the partners' material contributions (e.g. cash and in-kind), and (b) funds you have requested from other sources for proposed research related to this application.

Full organization name Contribution type	Confirmed	Year 1 Year 5	Year 2	Year 3	Year 4
	☐				
	☐				
	☐				
	☐				
	☐				
	☐				
	☐				
	☐				
	☐				
Total funds from other sources		0	0	0	0
		0			

Personal infomation will be stored in the Personal Information Bank for the appropriate program.

Application WEB

PROTECTED B WHEN COMPLETED

Family name, Given name
Nicoladis, Elena

Suggested Assessors - List up to 3 Canadian or foreign specialists whom SSHRC may ask to assess your proposal.
List keywords that best describe the assessor's areas of research expertise. Please refer to the Suggested Assessors section of the detailed instructions for more information on conflicts of interest.

Family name	Given name	Initials	Title
Naigles	Letitia		Dr.

Org. code	Full organization name	Keywords
	University of Connecticut	verb learning; language acquisition

Department/Division name
Psychology

Address 406 Babbidge Road, Unit 1020

	Country code	Area code	Number	Extension	City/Municipality	Prov./State	Postal/Zip code
					Storrs	CT	06269
Telephone number	+1	860	486-4942		Country UNITED STATES		
Fax number							

E-mail letitia.naigles@uconn.edu

Family name	Given name	Initials	Title
Kita	Sotaro		Dr.

Org. code	Full organization name	Keywords
	University of Birmingham	gesture production; language acquisition

Department/Division name
School of Psychology

Address School of Psychology
Edgbaston
Birmingham

	Country code	Area code	Number	Extension
Telephone number	+44		(0)121 41 46	
Fax number				

Country UNITED KINGDOM

E-mail s.kita@bham.ac.uk

Family name	Given name	Initials	Title
Golinkoff	Roberta	M	Dr.

Org. code	Full organization name	Keywords
	University of Delaware	children's verb learning; grammar development

Department/Division name
School of Education

Address School of Education
206 Willard Hall

	Country code	Area code	Number	Extension	City/Municipality	Prov./State	Postal/Zip code
					Newark	DE	19716
Telephone number	+1	302	831-1634		Country UNITED STATES		
Fax number							

E-mail roberta@udel.edu

Personal information will be stored in the Personal Information Bank for the appropriate program.

Application WEB

PROTECTED B WHEN COMPLETED