# Exploring Cross-Language Communication for Children via a Word Guessing Game

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## ABSTRACT

Techniques and tools exist to allow children to create and share stories. However, challenges can arise when attempting to share stories across languages and cultures. In this paper we explore a novel approach to cross-language communication. Rather than work with natural language translation tools, we successfully explored the use of images in attempting to communicate a concept across the language barrier, and be able to confirm that the concept has been properly understood. Our initial exploration is framed within the context of a word guessing game, and shows that such an image-based exchange can allow cross-language communication.

### Author Keywords

User-centered Design, Children, Natural Language.

### ACM Classification Keywords

H5.2. User interfaces: Prototyping: User-centered Design.

## INTRODUCTION

Children around the world enjoy consuming and creating stories, and this can be supported with computes [4,5]. Projects such as the International Children's Digital Library (ICDL) are working to create multilingual collections of children's stories [1,2,3]. The ICDL Communities project [13,14] is exploring how children living in different parts of the world can create, share, and discuss their own stories. One of the significant barriers in creating a cross-cultural community is that of language. Even restricting the creation of stories to picture books, asking and answering questions about the story would seem to require the use of either automated translation tools, or a common language.

While some automated translation tools do exist they are limited in their range of languages. Ideally, the questions and answers shared in the ICDL Community would be able to be understood by children from all cultures. It is tempting to direct our focus on the communication between the child who created the story and the child that posed the question as a way to restrict the challenge. However, we know that within a community, there are many participants who observe the interactions of others rather than initiate their own conversations [15,16]. In our context, that means that children from a third culture can read questions posed and answered between children of a first and second culture.

In addition to these challenges, the existing automated techniques have inaccuracies and require accurate data entry in the original language. This last requirement is of particular concern when working with children, since it adds the additional barrier of good spelling and proper grammar on the part of the child.

The ICDL Communities project addressed this by using question templates, and creating pre-translated story elements and questions, as will be discussed in the next section. This paper seeks to explore the use of images as a common language in which children can supplement pre-translated answers. For example, if a child draws a picture of a cat and there is no predefined element that shows a cat, and then another child circled that drawing and asked "What is that?" there would currently be no way for the first child to reply. We set out to enable the answering of such a question with an image from a photo gallery rather than with text. In this preliminary study we found that it is possible for children to convey concepts (such as "happy" as shown in Figure 1-1) in this way.

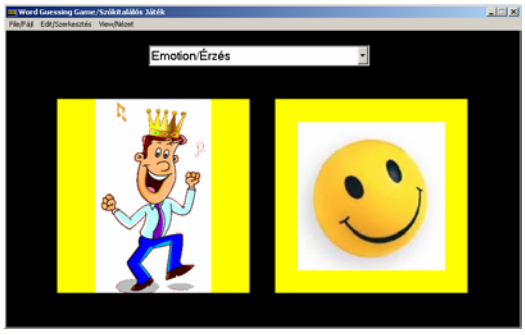


**Figure 1-1**
An example gallery with two images [10, 6].

## MOTIVATION – QUESTION TEMPLATES

In order to support interaction between children from different cultures, ICDL Communities needed a way for questions asked by children who spoke one language to be understood and answered by children who spoke a different language, and for those answers to be understood as well. Based on experiences working with children in Argentina, Mexico, and the United States [13,14], it was found that common questions fell into three categories; emotions, actions, and relationships. For example, "Is the old man proud?" or "Is the old man teaching the boy?" (Figure 2-1) or "What is the relationship between the old man and the boy?" To begin to support questions of this type, a template-based system was implemented.

**Figure 2-1**
Question: "Is the old man teaching the boy?"

There are two template models; one with two slots and one with three slots. The two-slot template has spaces for a story element and an emotion/action/relationship element. The three-slot template has space for a story element, followed by an emotion/action/relationship element, followed by another story element. Each slot in a template can be filled with a pre-existing graphic element. Some examples of emotion elements are happy, sad, and proud. Examples of action elements include teach and help. Relationship elements include like and dislike. Each of these pre-existing elements has an icon and a set of pre-translated text descriptions associated with it.

Figure 2-2 shows a question template filled in to ask about the relationship between the Mango Tree and Ben in the story "Sweet, Sweet Mango Tree" written by Diane Browne and illustrated by Clovis Brown. Figure 2-3 shows a question template filled in to ask whether Ben is happy. Figure 2-4 shows a question template filled in to ask who helps the old man. For yes/no questions, the answer can be given by clicking on the text for "yes" or "no" (displayed in the local language). For fill-in questions, the answer can be given by selecting an element that provides the answer. For example, if the answer to the question posed in Figure 2-4 was "the Mango Tree" then you would drag the Mango Tree story element in to create the answer, as shown in Figure 2-5.

**Figure 2-2**
Question: "What is the relationship between the Mango Tree and Ben?"

**Figure 2-3**
Question: "Is Ben Happy?"

**Figure 2-4**
Question: "Who Helps the Old Man?"

**Figure 2-5**
Answer: "The Mango Tree Helps the Old Man."

In Figure 2-6 we see another example question with a pre-defined emotion element that might not be universally understood. With pre-defined elements, we are able to also provide meaningful tooltips in the supported languages, as shown in Figures 2-7 and 2-8.

**Figure 2-6**
Question: "Is the Old Man tired?"


**Figure 2-7**
Tooltip showing the meaning of the emotion element in English.


**Figure 2-8**
Tooltip showing the meaning of the same emotion element, but in Hungarian.

The ICDL Communities project has made significant progress with this technique [13]. However, a major challenge presented by this technique is the limited set of pre-translated story elements, emotions, actions, and relationships available. Ideally, the children could add new words spontaneously. However, this reintroduces the translation question. In an attempt to explore the viability of supplementing the pre-translated elements with child-created ones, we began with the question of how easy or difficult it is to narrow down the interpretation of a concept conveyed using images alone. To study that question, we designed a word guessing game using images from a photo gallery.

### THE WORD GUESSING GAME PROTOCOL

To explore whether pre-translated elements could be supplemented with child-created elements, so that new emotions, actions, and relationships could be created, as well as (for example) the ability for a question such as "What is that?" to be answered, we sought first to explore how a concept, expressed as a word or brief phrase, could be shared in such a way.

In our scenario, P1 would have a concept that they needed to convey to P2 without the use of natural language. P1 will create a small gallery of images selected from a large photo gallery and send this to P2. P2 will open this gallery and attempt to discern the concept being communicated. In an attempt to confirm the successful transmission of the concept, P2 will create a new photo gallery as a response to P1. If P1 looks at this gallery and is convinced that the concept has been correctly transmitted, then they are done. If P1 thinks that the concept has been incorrectly transmitted, P1 will create a new gallery to send to P2, and the exchange process is repeated.

As an example, Figures 3-1 through 3-4 present a sample gallery exchange showing an attempt to convey "spiral pasta" that is first interpreted as pasta in general, and is then understood as spiral pasta specifically. At the end of the interchange, P1 is convinced that the phrase "spiral pasta" has been conveyed. While we cannot be 100% certain that the exact word or phrase has been correctly conveyed, this type of query/response provides some degree of confidence that the meaning has been correctly understood.

In this paper images were found via Google Image Search, but in practice the images could be obtained in other ways. Examples include being drawn by the children or imported from digital cameras used by the children. If using a search engine (which might cause the same image to appear) the children would be told to select images that had not been used by the other "side" of the exchange.

P1 first sends:

and

**Figure 3-1**
First part of an example interchange of image [12,7] galleries in an attempt to communicate "spiral pasta" between two different groups.

P2 replies with:

**Figure 3-2**
Second part of an example interchange of image [9] galleries in an attempt to communicate "spiral pasta" between two different groups.

P1 replies to the incorrect image with:

**Figure 3-3**
Thrid part of an example interchange of image [11] galleries in an attempt to communicate "spiral pasta" between two different groups.

P2 replies with:

**Figure 3-4**
Fourth and final part of an example interchange of image [8] galleries in an attempt to communicate "spiral pasta" between two different groups.

In the process of developing this protocol, in the summer of 2005 we worked with the Kidsteam design group at the University of Maryland. One of the challenges that we discovered was the level of competitiveness generated by the concept of a game. Two of the teams created galleries that were meant to be "tricky" rather than easy to guess. In an attempt to avoid this condition in our trials, we did not stress to the children that this was an image ***game*** in which they were participating.

## THE SOURCE MATERIAL AND IMAGE GALLERY APPLICATION

To test this idea, we needed two resources. First, we needed an existing gallery of images from which to create the query/response galleries. Second, we needed a way in which to exchange galleries. We selected (primarily for convenience and the fact that there is an option called "strict safe search") Google's Image Search database as our source gallery. However, any photo gallery that allows the user to copy an image to the computer's clipboard to later paste will work. To exchange galleries, we implemented an application specifically for that task. The screen captures shown are of a version created for use with children in Baltimore and Hungary, so the text appears in English and Hungarian. However, simply replacing a language localization file can create local, language-specific versions.

The image gallery application allows the child to create a gallery of 1, 2, 3, 4, or 8 images. In working with the Kidsteam researchers in 2005, we found that there was rarely a desire to build a gallery of more than 6 images, but often the desire to build smaller galleries. The application also allows the child to provide a general category for the concept being represented. Again, working with Kidsteam, we settled on a short list of categories (Figure 4-1).

| Image Categories |
|---|
| Activity |
| Animal |
| Emotion |
| Food |
| Place |
| Thing |

**Figure 4-1**
The list of categories available in the word guessing game.

When a child or team of children is ready to create a gallery, they launch the image gallery application and select how many images they plan to place in the gallery (Figure 4-2). The number of images can be changed even after they start to build the gallery.

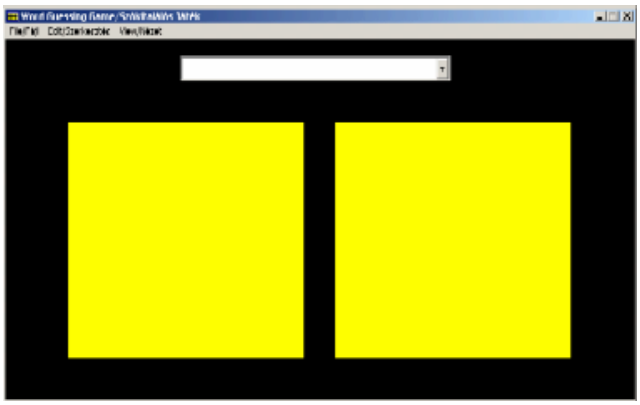

**Figure 4-2**
A blank two-image gallery in the gallery application.

In the dropdown list, they select one of the predefined categories. To populate the image gallery, the child performs a search at (for example) Google, clicks on an image they like to get its full-sized version, and then right-clicks the image and selects copy to bring it into the system clipboard. They then go to the image gallery application and right click over an empty image space. If there is already an image there, they are prompted with a question of whether they want to replace the existing image.

Figure 4-3 shows a completed gallery created while we were developing the concept. The four-image blank is shown with this gallery.

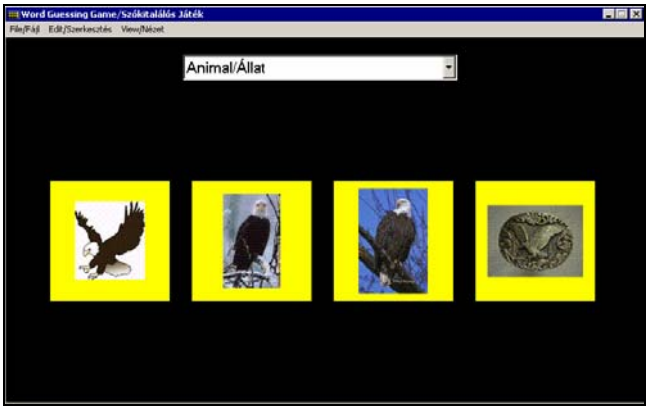


**Figure 4-3**
A completed four-image gallery.

Once completed, the gallery is saved to a single file, which can then be sent to the other site. For the game aspect (and for research purposes) the filename should not indicate the concept being conveyed to avoid "giving away" the answer (saving the gallery shown in Figure 1-1 in a file named **Happy.rgi** or the gallery in Figure 4-3 in a file named **Eagle.rgi** would make it a little too easy).

### BALTIMORE KIDS AND RESEARCHER

For our first trials with non-researcher participants, we worked with children at a private elementary school in Baltimore who were already participating in a project relating to ICDL Communities. There were three boys and three girls, aged 8-9, all in the 3rd grade. Children in this group were asked to convey five different concepts, in this case all individual words, to one of the researchers at the University of Maryland in College Park. Three teams were created; a mixed-gender team (T1), team of two girls (T2), and a team of two boys (T3). For space convenience, screen captures of the galleries have been cropped to show only the images.

Of the five galleries sent from the children, three of them (the galleries from T2 for "dog" and "pizza" and the gallery from T3 for "cake") appeared mostly straightforward in that there were clear themes to them. The gallery for "dog" showed several types of dog. The gallery for "pizza" showed several views of pizza. It is, however, worth noting that the "cake" gallery (Figure 5-3) did contain images (such as the bride and groom on the wedding cake) that might not be readily understood in this context by children in some cultures.

**Figure 5-1**
The gallery for "dog" created by Team T2.

**Figure 5-2**
The gallery for "pizza" created by Team T2.

**Figure 5-3**
The gallery for "cake" created by Team T3.

The first gallery from team T1 had a very interesting aspect to it - it told a story. Their gallery (Figure 5-4) showed the elements used to create their word - hamburger.

**Figure 5-4**
The gallery created by Team T1 for their first word - "hamburger".

The one gallery that presented a challenge was one of the two done by team T1. Their initial gallery for the second word is shown in Figure 5-5.

**Figure 5-5**
The initial gallery created by Team T1 for their second word.

Part of the challenge of this gallery was that the team forgot to set the category. However, the images also provided several possibilities. Figure 5-6 shows the guess gallery for the word "Green" that was sent to the children as a reply.

**Figure 5-6**
The initial guess gallery sent back to Team T1 for their second word.

The children realized that the word had not been conveyed, and they then created the gallery shown in Figure 5-7.

**Figure 5-7**
The second gallery from Team T1 for their second word.

As with the hamburger story, it became apparent that a sequence of images was being used to convey the target word. A new guess gallery for "Frog" as shown in Figure 5-8 was sent to the children, and they indicated that they felt the guess was now correct.

**Figure 5-8**
The final guess gallery sent back to Team T1 for their second word, correctly determined to be "frog".

This challenging gallery provided an honest opportunity to test out the response/query aspect of our protocol. The fact that it only took one extra iteration to correctly convey the desired concept is encouraging. In general, in this exploration we found that the desired concepts could be successfully conveyed using this technique in one or two iterations.

When talking with the researcher who worked with team T1 about this gallery, she said, "I know that they didn't want their galleries to be too easy and obvious, so they would try to come up with more challenging options as their hints for the word." This reinforces the previously discovered competition aspect of our approach.

**HUNGARY KIDS AND RESEARCHER**

For our second trials with non-researcher participants, we worked with children at a private elementary and high school in Hungary who were already participating in a project relating to ICDL Communities. There were 4 boys and 3 girls, aged 6-9. All seven children worked together in a single group. Children in this group were shown the image galleries that were created by the children and researcher in the exercise described in Section 5. This group of children was asked to guess the concepts represented by each gallery. The children were shown all of the galleries, both those created by the children in Baltimore to convey the concept and those created by the research at the University of Maryland to convey the guess.

When shown the "dog" galleries, all seven children guessed "dog" correctly. The same was true of the "pizza" galleries. However, when shown the initial gallery for "cake" (see Figure 5-3) they could not decide what concept was being conveyed. They began to call out the names of the objects they saw. This gallery was more varied, in some ways more abstract, and did contain some cultural metaphors. When the children were next shown the gallery representing the Maryland researcher's "guess" for the concept (Figure 6-1) one child guessed "pastries" while a second child guessed "cake" and then the remaining children all called out "cake" together.

**Figure 6-1**
Maryland researcher's "guess" for the concept conveyed in Figure 5-3.

The next galleries shown were for "hamburger". For the gallery created by the Baltimore children (see Figure 5-4) the children took some time to list out the elements they saw, and then one child guessed "hamburger" as the concept. For the gallery created by the researcher at Maryland (Figure 6-2) five of the children guessed "hamburger" but one of the children guessed that the concept was "preparing a hamburger." The reason for this was a software error that caused the category for the gallery to be listed as "Activity" rather than "Food". This highlighted the important role that the category could play in the interpretation of a gallery.

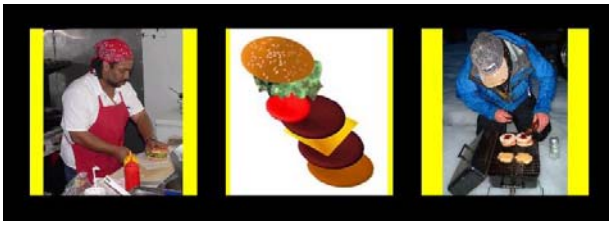

**Figure 6-2**
Maryland researcher's "guess" for the concept conveyed in Figure 5-4.

The final galleries were for the concept "frog". For the first gallery (see Figure 5-5) there were many different guesses at the concept. Three of the children guessed that "the color green" was the concept. This actually matched the researcher's guess during the Baltimore experiment, rather than the actual concept. The software error caused this gallery to be categorized as an activity as well, and four of the children guessed that "fishing" was the concept being conveyed. For the next gallery (see Figure 5-6) the guesses were initially "forest," "trees," and "leaf." It was then noted that the category was listed as "Activity" and four children guessed "logging" as the category. The third gallery in this set correctly (see Figure 5-7) displayed the category as "Animal" and four children guessed "frog" as the concept. However, one child guessed the "transformation of a frog," at which point all seven children decided that the gallery was for the concept "development". The fourth and final gallery for this concept (see Figure 5-8) also correctly displayed the category, and for this one half of the children guessed "frog" and the other half guessed "toad" as the concept.

In all cases, the students did guess the concept correctly by the final gallery in each set. This overall result was encouraging since we found that participants viewing galleries created by other parties could successfully determine the desired concepts.

## CONCLUSIONS

We have introduced a novel approach to cross-language communication. By exchanging galleries of images, we showed that children were able to exchange concepts with a remote person. In our study we saw that even with an incorrect start, the bidirectional nature of this approach allows for the identification of an incorrect interpretation and supports correction and clarification. We also showed that children who spoke a different language than those involved in the original exchange were able to determine the concept that had been communicated. Both of these aspects are important for cross-language communication between children in online communities.

In Figure 5-3 we saw the use of an image representing a bride and groom which is commonly found on top of a wedding cake in some cultures. The gallery is meant to have a variety of images, with the intent of conveying the concept in a number of different ways. However, further research will be needed to explore the range of concepts that can be conveyed using this technique and whether there are certain languages and/or cultures that would introduce new challenges to this approach.

## FUTURE WORK

This preliminary exploration of conveying answers via images rather than text shows promise. The next question is whether this technique will truly extend to full cross-cultural exchanges. The next step in this work will be to work with children at three sites in two different countries. The first stage will involve playing the word guessing game between children in each country and a researcher. This will teach the children how to play the game. The second stage will involve playing the game between children at two different sites in the same country. This will allow an incremental exploration of the technique where the researcher has been removed, but where the children come from the same culture. The third stage will involve playing the game between children at two sites in different countries. This will truly test cross-cultural exchanges between children. The final stage will involve having children at the site who were uninvolved in the third stage determine what concepts were being conveyed in that stage. This will more fully test the ability of a third-party to guess the concepts that were conveyed in a past conversation.

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