SRHRI Group 3 Project Report: Storytelling

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I. Introduction

This document is the first part of Group 3's SRHRI project report.

Our experiment consisted using a robot to tell stories to children to learn whether the introduction of a robot increased the children's story recollection and understanding.

The experiment took place between December 12 and 15, at Instituto Superior Técnico's child day care and had the participation of 19 children, ages 4-5 years old. We used a between subjects design with two groups, one group had the story told by a robot with figures allusive to the story and the other group only saw the figures. In both groups the story was narrated.

Since the subjects of the experiment were children, the story (available in Annex C) selected was simple and short, a four minute read.

The robot selected for this experiment was NAO and the software for the programming of the robot was the SERA framework, developed and provided by Instituto Superior Técnico. The group decided to use a Wizard of Oz approach, due to time and complexity restrictions, using KeepOnWindowShop as basis for the development of the source code. It was also provided a list of already defined animations for NAO, which could be used when programming the robot.

II. Story

The story selected for this experiment was *A que sabe a lua?* (*A Taste Of The Moon*, in English) by Michael Grejniec. This story narrates the adventures of a group of animals trying to reach the moon, to know how it tastes like, and calling their friends when they can't succeed alone, showing the importance of team work when trying to achieve a goal. The group selected this story seeing as it was short, proximately a 4 minute read and appropriate for children with ages 4-5, being one of the books recommended by Plano Nacional de Leitura[1]. Another factor taken into consideration when selecting the story was the emotions expressed in the text. The story selected expressed emotions such as sadness, when one animal couldn't reach the moon, and happiness, when they finally reached and tasted the moon, easy to translate through the robot's movements.

[1]An initiative of the Portuguese Government created in 2006 to promote literacy in Portugal

III. Robot

As mentioned before, the idea was to have a robot read a story to children while expressing its feelings through animations. To be able to have a robot capable of articulating movements and gestures while telling a story, the robot needed to have a full-body and articulations capable of moving. Of the several robots available in GAIPS, NAO fulfilled all these requisites and was the chosen robot for this study. NAO robot is presented in Fig. 1.

There were also several animations programmed already for NAO that could be used. These animations are detailed in Section IV.

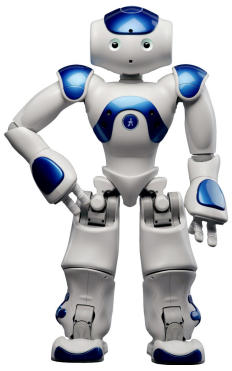


Fig. 1. NAO robot, developed by SoftBank Robotics.

IV. Implementation

The first step of the implementation was the analysis of the defined animations and association of those with emotions expressed in the story selected. The selection of keywords, such as "called" ("chamou" in the text used, in Portuguese), "reached" ("esticavam"), "no" ("não") and "thought" ("pensou"), or question marks, helped when identifying which animations could be programmed in NAO.

The implementation of the source code in NAO was simple since KeepOnWindowShop source code covered all the communication with the robot and libraries needed to access the animations. The form resultant (source code available in Annex A) had nine buttons, as shown in Figure 2, each one responsible for one specific animation (source code available in Annex B), as follows:

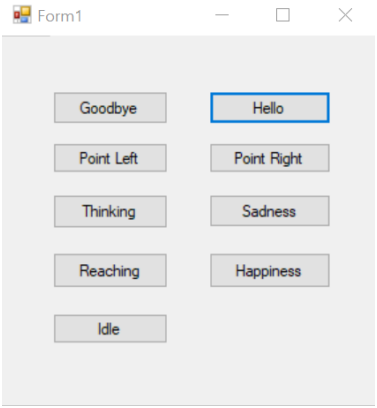


Fig. 2. Form implemented and used in this study

- **Goodbye** - This button runs the "goodbye" animation, expressed in NAO by having it reach out its arm and wave;
- **Hello** - Similar to Goodbye, this button runs the "greeting" animation, making the robot raising its arm and giving a small wave;
- **Point Left** - This button is responsible for running the animation "PointPlayerLeft", which would make the robot lift its left arm and point forward with one finger;
- **Point Right** - This button runs the "PointPlayerRight" animation, similar to PointLeft but the robot lifts its right arm instead;
- Thinking - This button runs the "rodinThinking" animation, making the robot lift its arm to its head and nod slightly, giving the perception that it is thinking;
- **Sadness** - The animation chosen to display sadness was "sadnessNodding", where the robot looks down and nods its head horizontally;
- **Reaching** - This button runs the "enthusiasm" animation. This animation was chosen to represent the robot reaching for something because when performing it, the robot raises its arms as if it wants to touch something. Since this story was about trying to touch the moon, the group thought it was appropriated and expressed the intended emotion;
- **Happiness** - For the Happiness button, the animation chosen was "happy", which makes the robot raise its arms and head. This might seem similar to the "enthusiasm" animation but the timing of the animations differentiated the two;
- **Idle** - this button runs the "endPose" animation and was included to make the robot return to an idle position.

V. Experiment

A. Setup

The experiment was setup in the principal's office. Figure 3 depicts the arrangement in the scenario where the subjects interact with NAO (the setup of the one where subjects do not interact with NAO is the same as this one but without NAO). NAO was placed on a table, with a computer in front of it. NAO moved in accordance with the story and the computer displayed images of the story, to make it easier to understand. Subject's were seated in front of the table, at a height that made their eye level the same as NAO (this was done intentionally to ensure the computer did not block view of the robot). The group members were seated on the couch at the entrance of the room, behind the line of sight of the subjects, and NAO was controlled from there as well.

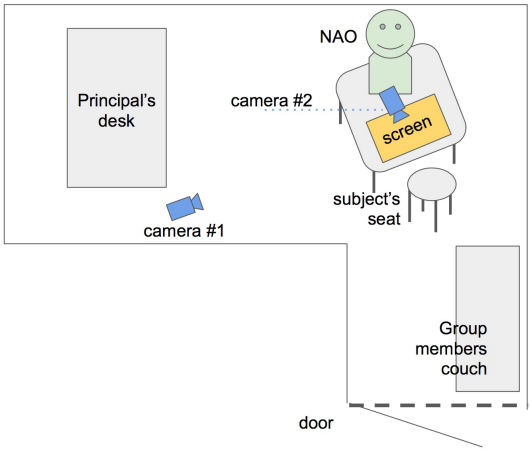


Fig. 3. Experiment's setup

B. Procedure

The study subjects were located across three different classrooms. A subject was escorted from the classroom to the experiment room by one of the group members. Before having the subject leave the classroom it was made clear to her/him that she/he was free to not participate in the study and could walk away at any point if she/he desired to do so. Upon arriving at the experiment room, the subject was introduced to NAO, who waived at her/him, and then was seated in front of the screen and NAO. At that time the group members would place themselves out of the subject's line of sight and the group member controlling the robot would initiate the story telling action.

After the story ended, the subject was moved out of the room and seated across one of the group members who performed a verbal questionnaire to assess the subject's understanding of the story and their feelings towards the interaction with NAO.

After the questionnaire, the subject was led back to her/his classroom.

APPENDIX A
FORM1.DESIGNER.CS

```
namespace WindowShopWoZ
{
    partial class Form1
    {
        /// <summary>
        /// Required designer variable.
        /// </summary>
        private System.ComponentModel.IContainer components = null;

        /// <summary>
        /// Clean up any resources being used.
        /// </summary>
        /// <param name="disposing">true if managed resources should be disposed; otherwise, false.</param>
        protected override void Dispose(bool disposing)
        {
            if (disposing && (components != null))
            {
                components.Dispose();
            }
            base.Dispose(disposing);
        }

        #region Windows Form Designer generated code

        /// <summary>
        /// Required method for Designer support - do not modify
        /// the contents of this method with the code editor.
        /// </summary>
        private void InitializeComponent()
        {
            this.button1 = new System.Windows.Forms.Button();
            this.button2 = new System.Windows.Forms.Button();
            this.button3 = new System.Windows.Forms.Button();
            this.button4 = new System.Windows.Forms.Button();
            this.button5 = new System.Windows.Forms.Button();
            this.button6 = new System.Windows.Forms.Button();
            this.button7 = new System.Windows.Forms.Button();
            this.button8 = new System.Windows.Forms.Button();
            this.button9 = new System.Windows.Forms.Button();
            this.SuspendLayout();
            //
            // button1
            //
            this.button1.Location = new System.Drawing.Point(235, 65);
            this.button1.Margin = new System.Windows.Forms.Padding(4, 5, 4, 5);
            this.button1.Name = "button1";
            this.button1.Size = new System.Drawing.Size(138, 39);
            this.button1.TabIndex = 0;
            this.button1.Text = "Hello";
            this.button1.UseVisualStyleBackColor = true;
            this.button1.Click += new System.EventHandler(this.button1_Click);
            //
            // button2
            //
            this.button2.Location = new System.Drawing.Point(58, 65);
            this.button2.Margin = new System.Windows.Forms.Padding(4, 5, 4, 5);
            this.button2.Name = "button2";
            this.button2.Size = new System.Drawing.Size(130, 39);
            this.button2.TabIndex = 1;
            this.button2.Text = "Goodbye";
            this.button2.UseVisualStyleBackColor = true;
            this.button2.Click += new System.EventHandler(this.button2_Click);
            //
            // button3
            //
            this.button3.Location = new System.Drawing.Point(58, 184);
            this.button3.Name = "button3";
            this.button3.Size = new System.Drawing.Size(130, 40);
            this.button3.TabIndex = 2;
            this.button3.Text = "Thinking";
            this.button3.UseVisualStyleBackColor = true;
```

```
            this.button3.Click += new System.EventHandler(this.button3_Click);
            //
            // button4
            //
            this.button4.Location = new System.Drawing.Point(235, 184);
            this.button4.Name = "button4";
            this.button4.Size = new System.Drawing.Size(138, 39);
            this.button4.TabIndex = 3;
            this.button4.Text = "Sadness";
            this.button4.UseVisualStyleBackColor = true;
            this.button4.Click += new System.EventHandler(this.button4_Click);
            //
            // button5
            //
            this.button5.Location = new System.Drawing.Point(58, 252);
            this.button5.Name = "button5";
            this.button5.Size = new System.Drawing.Size(130, 41);
            this.button5.TabIndex = 4;
            this.button5.Text = "Reaching";
            this.button5.UseVisualStyleBackColor = true;
            this.button5.Click += new System.EventHandler(this.button5_Click);
            //
            // button6
            //
            this.button6.Location = new System.Drawing.Point(235, 252);
            this.button6.Name = "button6";
            this.button6.Size = new System.Drawing.Size(138, 41);
            this.button6.TabIndex = 5;
            this.button6.Text = "Happiness";
            this.button6.UseVisualStyleBackColor = true;
            this.button6.Click += new System.EventHandler(this.button6_Click);
            //
            // button7
            //
            this.button7.Location = new System.Drawing.Point(58, 323);
            this.button7.Name = "button7";
            this.button7.Size = new System.Drawing.Size(130, 35);
            this.button7.TabIndex = 6;
            this.button7.Text = "Idle";
            this.button7.UseVisualStyleBackColor = true;
            this.button7.Click += new System.EventHandler(this.button7_Click);
            //
            // button8
            //
            this.button8.Location = new System.Drawing.Point(58, 125);
            this.button8.Name = "button8";
            this.button8.Size = new System.Drawing.Size(130, 35);
            this.button8.TabIndex = 7;
            this.button8.Text = "Point␣Left";
            this.button8.UseVisualStyleBackColor = true;
            this.button8.Click += new System.EventHandler(this.button8_Click);
            //
            // button9
            //
            this.button9.Location = new System.Drawing.Point(235, 125);
            this.button9.Name = "button9";
            this.button9.Size = new System.Drawing.Size(138, 35);
            this.button9.TabIndex = 8;
            this.button9.Text = "Point␣Right";
            this.button9.UseVisualStyleBackColor = true;
            this.button9.Click += new System.EventHandler(this.button9_Click);
            //
            // Form1
            //
            this.AutoScaleDimensions = new System.Drawing.SizeF(9F, 20F);
            this.AutoScaleMode = System.Windows.Forms.AutoScaleMode.Font;
            this.ClientSize = new System.Drawing.Size(426, 402);
            this.Controls.Add(this.button9);
            this.Controls.Add(this.button8);
            this.Controls.Add(this.button7);
            this.Controls.Add(this.button6);
            this.Controls.Add(this.button5);
            this.Controls.Add(this.button4);
            this.Controls.Add(this.button3);
```

```
            this.Controls.Add(this.button2);
            this.Controls.Add(this.button1);
            this.Margin = new System.Windows.Forms.Padding(4, 5, 4, 5);
            this.Name = "Form1";
            this.Text = "Form1";
            this.FormClosing += new System.Windows.Forms.FormClosingEventHandler(this.Form1_FormClosing);
            this.Load += new System.EventHandler(this.button2_Click);
            this.ResumeLayout(false);

        }

        #endregion

        private System.Windows.Forms.Button button1;
        private System.Windows.Forms.Button button2;
        private System.Windows.Forms.Button button3;
        private System.Windows.Forms.Button button4;
        private System.Windows.Forms.Button button5;
        private System.Windows.Forms.Button button6;
        private System.Windows.Forms.Button button7;
        private System.Windows.Forms.Button button8;
        private System.Windows.Forms.Button button9;
    }
}
```

APPENDIX B
FORM1.CS

```
using EmoteCommonMessages;
using System;
using System.Collections.Generic;
using System.ComponentModel;
using System.Data;
using System.Drawing;
using System.Linq;
using System.Text;
using System.Threading.Tasks;
using System.Windows.Forms;
using Thalamus;

namespace WindowShopWoZ
{
    public interface IWindowShopPublisher : IThalamusPublisher, IFMLSpeech, Thalamus.BML.IAnimationActions{}

    public partial class Form1 : Form
    {
        private class WindowShopWoZ : ThalamusClient
        {
            private class WindowShopPublisher : IWindowShopPublisher
            {
                dynamic publisher;
                public WindowShopPublisher(dynamic publisher)
                {
                    this.publisher = publisher;
                }

                public void CancelUtterance(string id)
                {
                    throw new NotImplementedException();
                }

                public void PerformUtterance(string id, string utterance, string category)
                {
                    this.publisher.PerformUtterance(id, utterance, category);
                }

                public void PerformUtteranceFromLibrary (
                string id, string category, string subcategory, string[] tagNames, string[] tagValues)
                {
                    this.publisher.PerformUtterance(id, category, subcategory, tagNames, tagValues);
                }

                public void PerformUtteranceWithTags (
                string id, string utterance, string[] tagNames, string[] tagValues)
                {
                    this.publisher.PerformUtterance(id, utterance, tagNames, tagValues);
                }

                public void PlayAnimation(string id, string animation)
                {
                    this.publisher.PlayAnimation(id, animation);
                }

                public void PlayAnimationQueued(string id, string animation)
                {
                    throw new NotImplementedException();
                }

                public void StopAnimation(string id)
                {
                    throw new NotImplementedException();
                }
            }

            private WindowShopPublisher wsPublisher;

            public WindowShopWoZ()
                : base("WindowShopWoZ", "")
            {
```

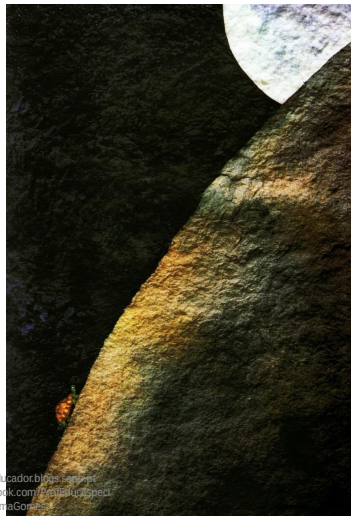
```
            SetPublisher<IWindowShopPublisher>();
            wsPublisher = new WindowShopPublisher(Publisher);
        }

        public void PeopleEntering()
        {
            wsPublisher.PlayAnimation("", "greeting");
        }

        public void PeopleLeaving()
        {
            wsPublisher.PlayAnimation("", "goodbye");
        }

        public void Thinking()
        {
            wsPublisher.PlayAnimation("", "rodinThinking");

        }

        public void Sadness()
        {
            wsPublisher.PlayAnimation("", "sadnessNodding");
        }

        public void Reach()
        {
            wsPublisher.PlayAnimation("", "enthusiasm");
        }

        public void Happiness()
        {
            wsPublisher.PlayAnimation("", "happy");
        }

        public void Idle()
        {
            wsPublisher.PlayAnimation("", "endPose");
        }

        public void PointLeft()
        {
            wsPublisher.PlayAnimation("", "PointPlayerLeft");
        }

        public void PointRight()
        {
            wsPublisher.PlayAnimation("", "PointPlayerRight");
        }
    }

    private WindowShopWoZ WoZ;

    public Form1()
    {
        InitializeComponent();
        WoZ = new WindowShopWoZ();
    }

    private void button1_Click(object sender, EventArgs e)
    {
        WoZ.PeopleEntering();
    }

    private void button2_Click(object sender, EventArgs e)
    {
        WoZ.PeopleLeaving();
    }

    private void Form1_FormClosing(object sender, FormClosingEventArgs e)
    {
        WoZ.Dispose();
    }
```

```
        private void button3_Click(object sender, EventArgs e)
        {
            WoZ.Thinking();
        }

        private void button4_Click(object sender, EventArgs e)
        {
            WoZ.Sadness();
        }

        private void button5_Click(object sender, EventArgs e)
        {
            WoZ.Reach();
        }

        private void button6_Click(object sender, EventArgs e)
        {
            WoZ.Happiness();
        }

        private void button7_Click(object sender, EventArgs e)
        {
            WoZ.Idle();
        }

        private void button8_Click(object sender, EventArgs e)
        {
            WoZ.PointLeft();
        }

        private void button9_Click(object sender, EventArgs e)
        {
            WoZ.PointRight();
        }
    }
}
```

APPENDIX C
STORY

Há muito tempo que os animais
desejavam averiguar a que sabia a lua.
Era doce ou salgada?
Só queriam provar um pedacinho.
À noite, olhavam ansiosos para o céu.
Esticavam-se e estendiam os pescoços,
as pernas e os braços, tentando atingi-la.
Mas era tudo em vão,
e nem o maior dos animais
era capaz de tocá-la.

Um belo dia, a pequena tartaruga
decidiu escalar a montanha mais
elevada para poder chegar á lua.



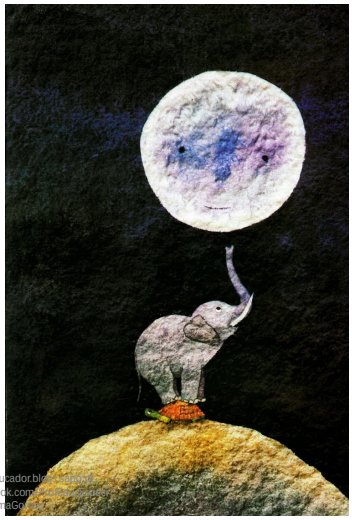
Vista lá de cima,
a lua estava mais próxima,
mas a tartaruga ainda não podia tocá-la.

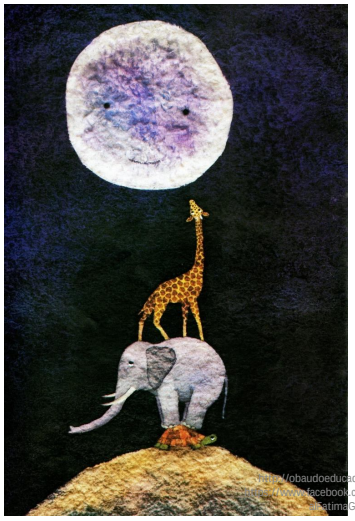
Então chamou o elefante.

- Sobe para as minhas costas, talvez cheguemos à lua.

A lua pensou que se tratava de um jogo e, à medida que o elefante se ia aproximando, afastou-se um pouco.

Como o elefante não pôde tocar a lua, chamou a girafa.





- Se subires para as minhas costas, melhor a alcançaremos.

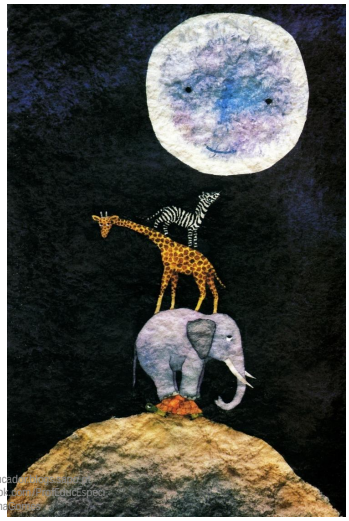
Mas ao ver a girafa,
a lua distanciou-se um pouco mais.
A girafa esticou, esticou o pescoço
quanto pôde, mas não serviu de nada.

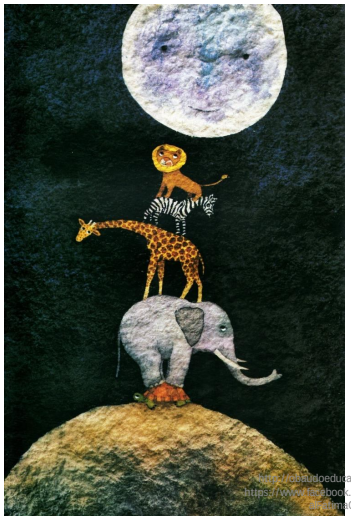
E chamou a zebra.

- Se subires para as minhas costas,
é provável que nos aproximemos dela.

A lua começava a divertir-se com aquele jogo e afastou-se outro pedacinho.

Também a Zebra não conseguiu tocar a lua e chamou o leão.





- Se subires para as minhas costas talvez possamos alcançá-la.

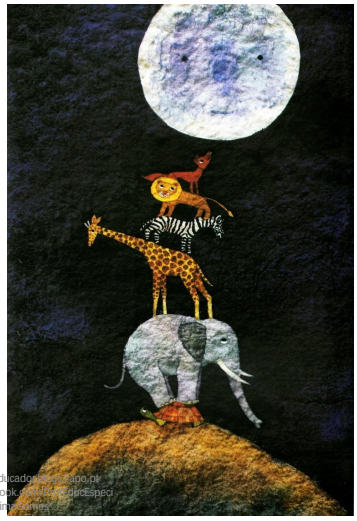
Mas quando a lua viu o leão,
tornou a subir um pouco mais.

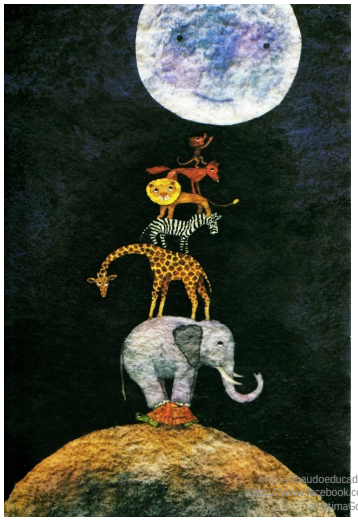
Também desta vez não consegui tocar a lua, e chamaram o raposo.

- Verás que conseguimos, se subires para as minhas costas – disse o leão.

Ao ver o raposo,
a lua afastou-se mais um pedacinho.
Agora só faltava um pouquinho de nada
para tocar a lua,
mas esta desvanecia-se cada vez mais.

E o raposo chamou o macaco.





- De certo, desta vez conseguimos.
  Anda, sobe para as minhas costas!

A lua viu o macaco e retrocedeu uma vez mais.
O macaco já podia cheirar a lua,
mas tocá-la, nem pensar!

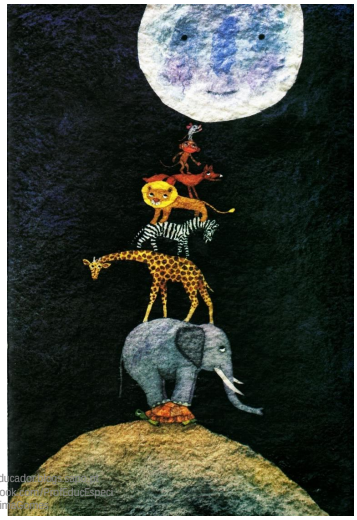
E chamou o rato.

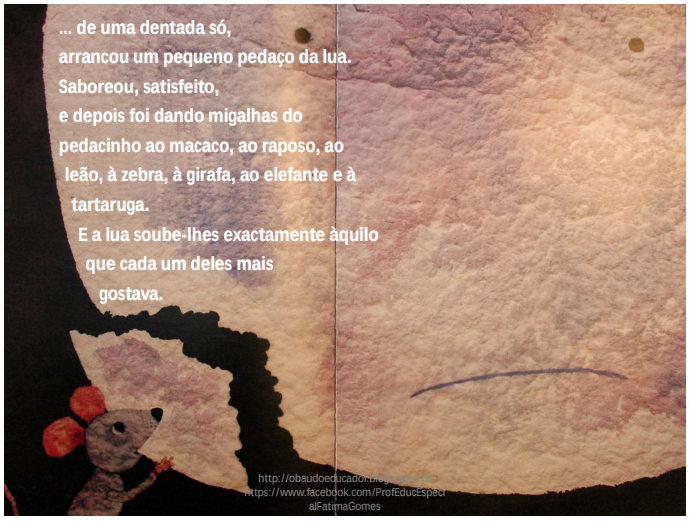
- Sobe para as minhas costas e
  tocaremos a lua.

A lua viu o rato e pensou:

- Um animal tão pequeno, certamente
  não poderá alcançar-me.

E como já começava a aborrecer-se
com aquele jogo
a lua ficou onde estava.
Então o rato passou trepando por cima
da tartaruga,
do elefante,
da girafa,
da zebra,
do leão,
do raposo,
do macaco
e ...





O peixe que tinha visto tudo sem entender nada, disse:

- Esta é boa! Tanto esforço para chegar à lua, lá em cima no céu, tão longe...
  Acaso não vêem que aqui na água há outra tão perto?