# Common Sense Assistant for Writing Stories that Teach Social Skills

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**Abstract**
People on the autistic spectrum often have difficulties with social interaction, and these difficulties are compounded when a person faces the uncertainty of not knowing what to expect in a new social setting. Detailed, step-by-step explanations of people's intentions and plausible actions can often help autistic people make sense of the situation, adapt to the social rules, and reduce stress associated with the social encounter. Carol Gray's Social Stories™ are carefully structured stories designed to prepare autistic people for everyday situations such as smiling at friends, waiting in a line, and staying calm in an audience when the speaker's slides don't match the handouts. Teachers or parents writing these stories often forget to include explanations of simple, "common sense" facts and simple variations of the story that might occur in different circumstances. We present a new tool that helps the writer explain salient points and think of more variations of the story. It uses a knowledge base of Common Sense sentences, Open Mind Common Sense, and inference in a semantic network, ConceptNet. We are investigating whether this new tool's suggestions are useful by examining how often the writers choose and use the suggestions that it generates.

**Keywords**
Autistic Spectrum Disorders (ASD), Common Sense Reasoning, Social Interaction

**ACM Classification Keywords**
Social and Behavior Sciences, User Interfaces, Applications and Expert Systems

## Introduction

Children and adults with autistic spectrum disorders (ASD) have difficulties reading, interpreting, and responding effectively to their social world [1]. From their point of view, people's intentions and plausible actions may at times seem to occur without meaning or identifiable purpose, appearing random and without warning or logic [1]. Some autistic people report that they have a less stressful experience if a situation is explained from their own perspective in advance [2]. The caregivers of the autistic children write the Social Story™ in the perspective of the autistic children explaining common facts and social rules in a certain situation of our daily lives to help the autistic children understand and be prepared for transitions in social interactions. Social Stories™ also help people with Semantic Pragmatic Disorder or hyperlexia who have similar difficulties in interpreting and responding properly to social cues [3, 4].

A relatively new field in the realm of artificial intelligence, common sense reasoning grows out of the belief that machines need to know mundane facts about the workings of the world in order to reason about everyday life in much the same way that humans do [5]. A common sense semantic network not only has a great deal of common sense concepts but also correlates relations of these concepts. For example, if the suggested concept to the common sense semantic network is "go to bed", it reasons out related concepts such as 'sleep', 'rest', 'take off clothes', 'close eyes', etc.

A common sense database like OpenMind [6] has a lot of similarities with the sentences written in Social Stories™ in that both of them explain a wide range of knowledge in everyday life rather than deep and profound knowledge in specific subjects. The differences between common sense data bases and the sentences in Social Stories™ are that the sentences written in the latter are written from a first person perspective as though the child is describing the event, in positive tone and sometimes come along with affirmative sentences to enhance the meaning of surrounding statements, often expressing a commonly shared value or opinion within a culture [1]. Our Social Story™ idea-toolkit makes use of these similarities and differences between the common sense data base and the sentences in Social Stories™ to provide Social Story™ writers with plentiful information relevant to the social context of their writing.

One of the difficulties in writing Social Stories™ is the task of considering a situation from the perspective of the child or adult with ASD. When the caregivers of the autistic children write the Social Story™, they might ignore common facts which need to be explained to help the child understand the situation because the fact is too trivial (common sense) for the writers. When teachers or parents of autistic children write a Social Story™, it is helpful to add many variations for children to be prepared for many possible situations. The closer a story can be to the situation the child will actually encounter, the more likely the child will understand and

be able to perform well in that situation. Another important thing in generating lots of variations for one theme is that the resulting stories can teach a lot of social qualities such as patience, cleanliness, safety, and friendship. Social skill learners with autism often have a difficulty generalizing what they have learned in one setting to another [7]. For example, a child with autism who learned to join peers during an art activity at school could be expected to make a smooth transition only at art group. By varying the settings when writing social stories, the caregivers can teach the learner to use the new social skill in different situations [7].

Our Social Story™ idea-toolkit provides a text input box into which the Social Story™ writer can enter the sentence. A common sense semantic network draws related concepts to the key phase from the submitted sentence after the Natural Language Processing Toolkit parses the sentence into key phases. These concepts retrieve relevant sentences from another common sense data base which has a lot of common sense on social interaction. We named this second common sense data base the 'Social Sense' database. The sentences in the Social Sense data base have positive assertions, one of the criteria used to define Social Stories™ that are intended to encourage and relax the children such as 'This is okay. I can wait for someone on a chair. Other people think I am a good person if I wait for someone'. The positive assertions are supposed to help increase self-esteem, which can lead to a willingness to tackle problems and accept new strategies [8]. Therefore, our system is implemented to 1) provide Social Story™ writers with many variations and inspire many thematic elements that can happen in one situation, 2) help the writers to see the situation from the perspective of autistic people, and 3) help the writers be able to make generalizations when they write or edit stories.

## Domain and Scenario

Our first task in building a prototype of the Social Story™ idea-toolkit is to narrow down the domain of possible writing themes. We need to do this for two reasons: First, the Social Sense database is not thoroughly populated yet, and second, the analogical reasoning in the common sense retrieval could still use more sophistication to work well across many writing themes. Thus, we restricted our domain to a small set of contexts where there are many examples in the database, in order to optimize our results. In this paper, we show examples from the domain of the teacher or parents of the autistic child writing Social Stories™ about going to visit a barber shop. In our imagined scenario, the autistic child is supposed to go to a barbershop with mom, and the teacher of the child writes Social Stories™ to help the child to be prepared for the many possible situations that can happen in a barbershop.

Our Social Story™ idea-toolkit provides the writer with possible events and scenes in a barbershop by retrieving related concepts from a common sense semantic network. It also provides the users with connection to other situations which, by analogy, require similar social qualities such as patience, cleanliness, friendship, safety, etc. Connecting to other situations may help the children to learn not only how to react at a barbershop but also how to react in similar situations in other places so that the autistic children can better generalize their comprehension about social interaction. For example, waiting in a barbershop can

also teach how to wait and why we have to wait in a bathroom, a dental office, or a theater. If the writer enters 'I can wait on chair for my turn', the Social Sense Variations results show other situations which can happen such as 'Stand in line', 'Get in line' activities.

## Natural Language Processing and Common Sense Semantic Network

We are using MontyLingua V.2.1 [9] as the Natural Language Processing Toolkit for our system. MontyLingua v.2.1 is a commonsense-enriched natural language processing toolkit for English that parses raw English sentence into adjective phrases, noun phrases, preposition phrases and verb phrases, which are good format to be a candidate for keywords from the sentence and to be fed into the common sense semantic network. We chose ConceptNet3 [10] for the common sense semantic network because it supports topic-jisting, affect-sensing and analogy-making.

## System Details

Our system works as follows. First, the user, usually the teacher or a parent of the autistic child, enters a sentence, for which s/he wants to see many related common facts, into the text input box in our Social Story™ idea-toolkit. This raw English sentence is fed into the Natural Language Processing Toolkit and the outputs are key phrases in the raw sentence such as noun phrases, adjective phrases, verb phrases.

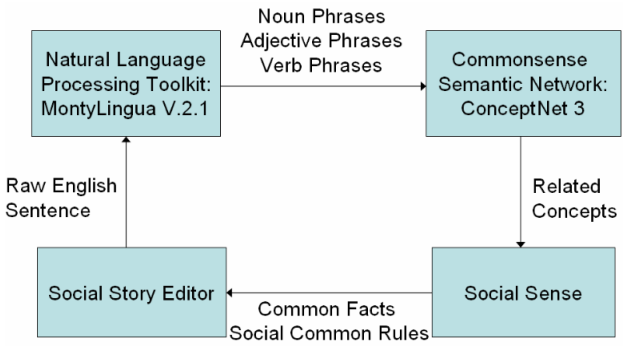


**Figure 1**. Social Sense Variation Workflow

These key phrases are automatically entered into the commonsense semantic network, which generates lists of related concepts. The lists of the related concepts from the commonsense semantic network retrieve sentences from the Social Sense database that contain the phrase of the related concepts. Figure 1 describes a diagram of how the whole system works. For example, if we enter a raw English sentence as 'why do I get my hair cut', we can get the verb phrase 'get' and the noun phrase 'hair cut'. These key phrases are fed to the commonsense semantic network and provide related concepts that can happen when people get their hair cut such as 'meet my friend', 'hair on floor', 'wait on chair for my turn', 'go to the hairdresser', 'barbershop' etc. Each of these results retrieves relevant sentence from the Social Sense database: for example, 'meet my friend' retrieves 'Sometimes I can meet my friend', while 'hair on floor' retrieves 'Sometimes I can see hair on the floor at a barbershop'. The reason why we made the Social Sense database rather than providing results directly from the commonsense semantic network is that sentences written in the Social Story™

idea-toolkit are supposed to be in first-person and present-tense style. Also some of the results from the commonsense semantic network are not relevant to be written in a Social Story™.

## User Interface Details

Figure 2 shows the user interface design of our Social Story™ idea-toolkit. Following guidelines established by Carol Gray [1], it encourages composing the Social Story™ in three parts: introduction, body, and conclusion. The left side of the user interface contains a text input box for entering the title, introduction, body, and conclusion. After writing a story the writer can save the story clicking the 'save' button. There is also a 'Selected Sentence' text box in the upper part of the user interface. The sentence entered in this box can be submitted to find a lot of variations for this situation by clicking the 'submit' button. Figure 2 is an example of writing a Social Story™ about a visit to a barbershop. When the user submits 'I can wait on a chair for my turn', the 'Social Sense Variations' on the right side of the user interface provides not only how to respond to this situation but also why people respond in this way. Providing explanations why people act like that also makes a connection to another Social Story™. For example, one of the results from submitting 'I can wait on a chair for my turn' is about 'getting in line at a restroom'. In this case we can make a connection between the 'getting in line at a restroom' Social Story™ and the 'barbershop' Social Story™. The Social Story™ book [1] is suggested as an outline for Social Story™ writers.

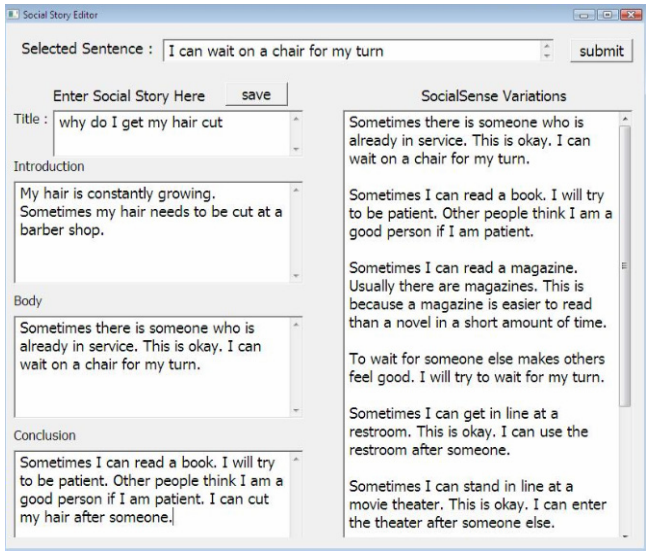


**Figure 2.** User Interface Screenshot

Providing variations and connecting different stories together help them make use of the suggested outline from Social Story™ book.

## Evaluation and Results

We conducted an informal user study of our prototype system with 2 Social Story™ writers. The participants are selected from those who have some experiences in children education or care. The evaluation task was for the writers to compose Social Stories™ at a barber shop without and with Social Stories™ idea-toolkit. One participant wrote the story in second-person future-tense sentence without the system but first-person present-tense and got four more writing themes 'keeping clean and healthy', 'waiting in a barber shop', 'paying the barber' 'meeting my friend' with the system. This participant was good at composing stories

and making smooth connections with other Social Stories™ such as the 'smiling' and 'saying hi' stories when seeing the Social Sense Variation results. The other participant wrote the story in second-person or third-person present-tense sentences without the system but in first-person present-tense sentences with the system and got three more writing themes 'keeping clean and healthy', 'paying the barber' 'meeting my friend' with the system. This participant was likely to use the sentences directly from the Social Sense Variation results rather than change them into different language and connected the 'paying at a barber shop' story to the 'paying at a toy shop' story with the system.

## Future Work

This work is a first-step toward a Social Story™ Editor. Our future goal is to make a web-based Social Story™ Editor that can provide writers useful variations demonstrated in this work, check Social Story™ criteria and provide relevant illustration images (e.g., it could easily consult Google images). Accumulating comprehensive data in our Social Sense database especially from good writers will help a lot of novice Social Story™ writers over the internet. Pictures will also help children with autism rehearse the situation and learn new social skills. While it may sound counter-intuitive to ask autistic people to contribute, it is actually the case that many autistic people are quite observant of details of human interaction that non-autistic people may not notice (although often it is easier for them to do this when not face-to-face in the social situation) and it would be great to encourage them to contribute writing. Autistic people who have more social experience may be especially good at helping populate the Social Sense database to teach less-experienced autistic people.

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