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Preschoolers' Recognition of the Transmission of the COVID-19 Virus: A Pilot Study

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Abstract

The following two studies examined preschoolers' recognition of the transmission of COVID and the cold virus. Study 1 examined preschoolers' recognition of the impact of symptomatic and asymptomatic conditions without social distancing in the transmission of the COVID virus. Study 2 examined the role of social distancing in the transmission of the cold virus. Results of Study 1 indicated that preschoolers recognize the transmission of the COVID virus both in the symptomatic and asymptomatic conditions. Study 2 demonstrated that preschoolers take into account the proximity factor when assessing the probability of the transmission of the common cold. The results of both of these studies strongly support the theory that children have an autonomous theory of biology in the preschool years.

Keywords: Preschoolers' Recognition, COVID-19 Virus, Pilot Study

1. Introduction

The SARS-CoV-2 pandemic has presented the kind of challenge that no other virus has in the past few centuries. Not only has the virus disrupted billions of people's lives but the nature of the virus is different from other viruses that we have encountered. In order to contain the spread of the virus and to 'flatten the curve', it is imperative that we discover the biological beliefs that children and adults have about how the virus is transmitted and how the transmission can be curtailed.

One of the important questions is why is it important to study children's and adults' understanding of the prevention and transmission of the SARS-CoV-2 when we have a plethora of research on children's understanding of other common viral infections such as the flu and common cold (Kalish, 1996)? As with any contagious illness, children are often the vital link to the transmission of contagious illnesses since they frequently engage in transmittable behaviors such as touching their faces, not washing their hands, sharing juice boxes, etc. Second, there is consensus in the medical community that the main mode of transmission is through air droplets which is different from other common contagious illnesses like the common cold (where the main mode of transmission is through contact with infected hard surfaces such as door knobs). Third, a person can be asymptomatic and transmit the virus without even knowing that he/she is a carrier of the virus whereas with the cold virus, one usually has to have symptoms to be contagious. Fourth, the death rates for the SARS-CoV-2 virus is higher than for the flu (1.3% vs, .01%). Finally, even though there is a vaccine for the SARS-CoV-2, similar to the flu vaccine, people can still contract the Covid virus but might avoid hospitalization or death. The first four reasons cited above, make the SARS-CoV-2 different from other contagious viruses which in turn makes it important to study children's and adults' reasoning about the transmission of the Covid virus.

There are also theoretical and practical merits to exploring this topic. Theoretically, it will further contribute to the literature on children's understanding of biology on whether children have a autonomous theory of biology. Practically, this data will be of value to medical practitioners and educators so that they can correct any misconceptions children might have about the transmission of the Covid virus.

1.1 Background Studies

There have been several studies that have examined children's recognition of the transmission of contagious and non-contagious illness. Sigelman, Jami and D'Andrea (2022) reported that there are four views of children's understanding of the transmission of illness. The first is the contagion or the germ theory where a person contracts

an illness from being in contact with or being in close proximity with someone who is sick, which in turn results in the transmission of germs at a later stage (Kalish, 1996; Solomon & Cassimatis, 1999; Wellman & Gelman, 1992). DeJesus, Venkatesh and Kinzler (2021) examined children's understanding of close interactions as being an important factor in disease transmission. The results demonstrated that young children can use information about the proximity of interactions to determine if a disease will spread or not with children across all age groups reasoning that proximity with a sick person will result in the person getting sick.

The second view is the contamination theory where something that is dirty causes the illness. Preschool age children seem to recognize that sharing juice boxes is unhealthy or eating moldy bread covered by a bread spread is problematic (Siegal et al., 2011; Siegal & Share,1990). The key difference between the contamination theory and contagion theory is that there is no explicit recognition of germs causing the illness.

The third view is what Sigelman et al., (2022) report as the unhealthy lifestyle theory of illness. This view attributes illness to a variety of unhealthy practices such as eating unhealthy food, not exercising, smoking, and using alcohol or drugs. There have been some studies that have demonstrated that young children understand that both healthy eating and physical activity are responsible for good health. Lanigan (2011) found that 3 to 5 year old children have a better understanding of the benefits of healthy eating compared with physical activity. Forty percent of children classified snacks eaten outside of mealtimes as unhealthy. Nguyen et al., (2011) showed that teaching 4-year-olds simple causal explanations of how different foods and activities affect health was more beneficial in improving children's understandings compared to educational messages that did not include causal mechanisms. Both of these studies demonstrate the impact of nutrition and physical activities on health.

A few studies have examined preschoolers' understanding of non-contagious illnesses like cancer and genetically transmitted illnesses. Varkula (2010) found that preschoolers have some knowledge of what the word 'cancer' means but thought of it as a sickness or illness. Bares and Gelman (2008) found that preschoolers thought cancer was like colds and was caused by germs and thought to be contagious. The conclusion was that young children probably assimilate an unfamiliar illness like cancer into their concept of familiar diseases like colds.

Williams and Binnie (2002) assessed an intervention to educate 4- and 7-year-olds about the causal contributors to and symptoms of a contagious illness, a noncontagious illness, and an injury (chickenpox, asthma, and scraped knee, respectively). It was found that preschoolers attributed cancer to psychological factors like worrying but formulated a coherent biological theory of contagious illness and a physical or mechanistic theory of injury. This suggests that preschoolers have minimal knowledge of what cancer is and how it is transmitted.

Raman and Gelman (2005) examined if preschoolers can attribute different modes of transmission to genetic disorders and contagious illnesses. In the presence of kinship cues, children distinguished genetic disorders from contagious illnesses, but in the presence of contagion cues, preschoolers selectively applied contagious links primarily to contagious illnesses. With novel illnesses, preschoolers and adults inferred that permanent illnesses were more likely to be transmitted by birth parents than by contagion. These results suggest that by the preschool years, children seem to recognize that not all disorders are transmitted exclusively through germ contagion.

Finally, another set of studies have examined the role of psychological factors on biological processes such as illness transmission (Raman & Gelman, 2007; Raman, 2009). These studies suggest that both preschoolers and adults entertain a highly sophisticated and selective process when assessing, the impact of psychological factors (with children taking into account the intentionality of the person as a motive to whether the person would get sick or not) on illness transmission.

The present study that focuses on COVID-19 transmission in different conditions and analyzes preschoolers understanding of this transmission. Even with the lack of child focused research on the COVID-19 virus, we know that the cold virus is similar to the COVID-19 virus in various ways. Children recognize that COVID-19 is similar to the cold because of their similar symptoms (coughing, sore throat, stuffy nose, etc.), the increased encouragement to wash hands, and the need to stay home when sick. These are all things they have heard adults say when referring to a cold. Given the similarity of the two viruses, we expect children to have some basis of understanding of the transmission of the COVID-19 virus. On the other hand, there are also differences that children pick up on such as some nontypical cold symptoms (stomach issues, taste/smell loss, and fevers), the need to wear masks, and having to social distance even when they seem healthy. These differences might make it harder for children to fully understand the COVID-19 virus.

The research questions that are examined by the following two studies are: (a) Do preschoolers recognize the transmission of the COVID virus in the presence of symptomatic and asymptomatic conditions? (b) Do the conditions such as social distancing have an impact on preschoolers understanding of the transmission of the

COVID-19 virus? (c) Is there a difference in preschoolers' understanding of the transmission of the cold virus compared to the COVID-19 virus?

Study 1 examines preschoolers' understanding of the transmission of the COVID-19 virus with symptomatic and asymptomatic conditions without social distancing. This study directly examines the role of social distancing and how that might affect transmission of COVID in symptomatic and asymptomatic cases. Kalish (1996) demonstrated that children seemed to be able to recognize that invisible entities like germs cause illness, thus children in this study might be able to reason that the virus will be transmitted at least in the symptomatic condition. Study 2 served as a control study to examine preschoolers' understanding of the transmission of the common cold virus with and without social distancing.

Control questions that described non-contagious ailments were included in both studies for comparison purposes. This would help determine preschoolers' understanding of the transmission of contagious viruses, such as COVID-19 and the cold, compared to noncontagious ailments (headache, toothache, scraped knee, and bruised knee). It will uncover not only children and adults' scientific knowledge (or lack of) about the prevention of the transmission of the virus but will also reveal if children have a coherent or fragmentary biological theory when reasoning about the COVID virus.

2. Study 1

In Study 1, we examined the difference in preschoolers' beliefs about the transmission of COVID-19 virus between non-socially distanced individuals who are symptomatic and asymptomatic.

2.1 Methods

2.1.1 Participants

There were 24 participants in this study, that were separated in to two conditions. The first condition that focused on symptomatic COVID-19 transmission without social distancing, consisted of 12 preschoolers, 5 boys and 7 girls (mean age of approximately 4 years 6 months; age range of approximately 4 years 1 month to 4 years 11 months). The second condition that focused on asymptomatic COVID-19 transmission without social distancing, included 12 preschoolers, consisting of 4 boys and 8 girls (mean age of approximately 4 years 7 months; age range of approximately 4 years 1 month to 5 years 1 month). All participants were primarily Caucasian.

The children were recruited from four different preschools, located in three different local counties in the Midwest. Active parental consent was then obtained for each preschooler participant across all three studies. The only restriction was that participants had to be fluent in English.

2.1.2 Materials

In both conditions, the preschool children were given a set of 12 items (8 test questions and 4 non-contagious ailments control questions). For the symptomatic COVID-19 condition, each of the vignette test questions consisted of one of the following symptoms – fever, cough, sore throat, fatigue (tired), trouble breathing, loss of taste and smell, body aches and pains and stuffy nose. The four control questions consisted of toothache, bruise, headache and scraped knee. The COVID-19 symptoms were selected because they are fairly common and identifiable in this age group. For the asymptomatic COVID-19 condition, the vignette test questions referred to the child being asymptomatic. The same non-contagious ailment control questions were used in both conditions. Sketched paper pictures (see attached pictures) of the vignette character were used to represent each symptom and scenario.

2.1.3 Procedure

Children were interviewed individually. They were shown colored paper sketches of the two child characters standing close together. For the asymptomatic COVID-19 condition, the symptomatic (COVID-19) child showed signs of the particular symptom and the other child looking happy/healthy. The purpose of using pictures was to hold the child's attention and clarify characters in the scenario. The experimenter read the vignettes to the children, pointing to the relevant characters when reading the vignette. The children were then asked to respond verbally or by pointing to the character in the picture. The experimenter wrote down the children's responses. An example of a vignette that described a symptomatic condition was the following:

There are two girls Anne and Jane. Anne has COVID so she has a fever. She feels very warm. Jane does not have a fever and she is healthy. Who has a fever (a) Anne; (b) Jane? Who is healthy (a) Anne; (b) Jane? Now remember I said that Anne has a fever and Jane is healthy. Ann and Jane are standing right next to each other. What do you think will happen? (a) Do you think Jane is likely to get sick from Anne? or (b) do you think Jane is not likely to get sick from Anne. Why do you think Jane is likely/not likely (depending on what answer the child gives for the first

part of this vignette) to get sick from Anne?

For the asymptomatic condition, the experimenter followed the same general procedure as done in the symptomatic condition. In the color sketch for this condition, the asymptomatic child and the healthy child both appeared happy/healthy to represent the characteristics of being asymptomatic. An example of a vignette that described a non-symptomatic condition was the following:

There are two girls Mary and Zoe. Mary has COVID but she is not showing any signs of having it. Zoe is healthy and does not have the COVID. Who has COVID (a) Mary; (b) Zoe? Who is healthy (a) Mary; (b) Zoe? Now remember I said that Zoe is healthy and Mary has the virus. Zoe and Mary are standing right next to each other. What do you think will happen? Do you think Zoe is likely to get sick from Mary or do you think Zoe is not likely to get sick from Mary? Why do you think Zoe is likely/not likely to get sick from Mary?

The order of the 8 test questions in both conditions (symptomatic and asymptomatic COVID-19) were randomized for each child. Following the test questions were the 4 control questions (non-contagious aliment) that were also randomized.

2.2 Results

In this study, we were interested in finding out whether children would predict that the healthy child would contract COVID-19 from the sick child between symptomatic and asymptomatic conditions when not socially distancing. Only participants who got at least 3 out of the 4 control questions were included in the final analysis, resulting in all 12 participants being included in the final analysis.

To analyze the data, we conducted a 1 (score total) x 2 (condition- symptomatic or asymptomatic) analysis of variance (ANOVA) test to determine if there was a difference in transmission understanding between the two conditions. Within this one-way ANOVA test with p (.118) > .05, it was determined that there is no statistically significant difference between the two conditions. Looking at the descriptive means of both conditions, the Mean for the symptomatic COVID condition is $M= 6.57$ while the mean for the asymptomatic COVID condition is $M=4.67$. The highest possible total score being 8.

At the end of each vignette, we asked the participant if they thought the healthy child would contract COVID from the sick child and to justify their responses as part of the experimental task. Examples of some explanations in which preschoolers provided for why the healthy child would contract COVID in the symptomatic condition were, “Cause he’s coughing.” and “Cause her hot”. An example in which stated that the healthy child would not contract COVID from the asymptomatic child was, “Because she won’t get coughed on.”

2.3 Discussion

The results of this study demonstrate that by the preschool years, children have a recognition of how the COVID-19 virus is transmitted in both the symptomatic and asymptomatic conditions. Interestingly, preschoolers seemed to recognize that even in the asymptomatic condition, the virus would be spread. This demonstrates and lends support to previous findings (Kalish, 1996; Raman & Gelman, 2005) that preschoolers have a solid recognition of the impact of the transmission of viruses. Moreover, this study supports the findings of DeJesus, Venkatesh and Kinzler (2021) that preschoolers recognize the transmission of a virus when they are in close proximity to each other. However, this study goes one step further to the DeJesus et al., (2021) study to demonstrate that preschoolers are capable of recognizing viral transmission even if there are no outwardly symptoms of the illness. At the same time, they do recognize that ailments are not contagious like viral based illnesses are (even if the person is in close proximity), so the factor of proximity is not the only variable that children are using to decide whether something is contagious or not. These results suggest that preschoolers seem to have a coherent and autonomous theory of biology by the preschool years.

The question this raises is, do preschoolers recognize that contagion is only possible if individuals are in close proximity? Study 2 examines this concept by testing preschoolers’ recognition of the transmission of a common cold in close proximity as well as social- distanced circumstances.

3. Study 2

In study 2, we study examined preschoolers’ beliefs about the transmission of the cold virus between socially-proximate and distanced individuals who demonstrate cold symptoms.

3.1 Methods

3.1.1 Participants

Participants included a total of 16 preschoolers, consisting of 8 boys and 8 girls (mean age of approximately 4

years 6 months; age range of approximately 4 years 5 months to 5 years 1 month). The children were recruited from one preschool (one of the same as used in Study 2). Half the children were assigned to the socially-proximate condition and the other half were assigned to the socially-distanced condition.

3.1.2 Materials

The preschool children were given a set of 10 items (3 cold symptoms with two vignettes for each symptom and 4 control non-contagious ailments). We varied the sex of the characters for the vignettes, so each symptom has a vignette with just male characters and another vignette with just female characters. The non-contagious items which were the same ones that we used for Study 1. Each of the vignettes stated that the character had a cold and an additional symptom to emphasize that it was a cold and not Covid. We decided to add an additional symptom so that the vignettes would not be repetitive. The cold symptoms were cold and cough, cold and a sore throat, and a cold and a stuffy nose. Sketched paper pictures of the vignette character were used to represent each symptom and scenario.

3.1.3 Procedure

Children were interviewed individually. They were shown colored paper sketches of the two child characters standing either close together or far apart from each other. The symptomatic (common cold) child showed signs of the particular symptom and the other child looked healthy. The purpose of using pictures was to hold the child's attention and clarify characters in the scenario. The experimenter read the vignettes to the children, pointing to the relevant characters when reading the vignette. The children were then asked to respond verbally or by pointing to the character in the picture. The experimenter wrote down the children's responses. The vignette then repeated who had the cold and who was healthy, stating they were standing close or further away from each other. Participants were then asked to verbally respond whether the healthy child would be likely to get the cold from the other child or not, and why they thought that would be the case. An example of a vignette that described a socially-distanced condition was the following:

There are two boys John and Michael. John has a cold and a cough. He is sniffling and coughing a lot. Michael does not have a cold or a cough and he is healthy. Who has a cold and cough (a) John; (b) Michael? Who is healthy (a) John; (b) Michael? Now remember I said that John has a cold and a cough and Michael is healthy. John and Michael are standing far away from each other. What do you think will happen? (a) Do you think Michael is likely to get sick from John? or (b) do you think Michael is not likely to get sick from John. Why do you think Michael is likely/not likely to get sick from John?

Vignettes that described the socially-proximate condition were identical except for the fact that it stated that the characters were standing right next to each other.

The order of the 6 test questions (symptomatic common cold virus) were randomized for each child. Following the test questions were the 4 control questions (non-contagious aliment) that were also randomized.

3.2 Results

In this study, we were interested in finding out whether children would predict that the healthy child would contract the common cold virus from the sick child when the characters were either standing right next to each other or social distancing. Looking at the descriptive mean for the socially distanced cold condition is M= 3.62 *(out* of a maximum of 6). The mean for the socially-proximate condition was 5.5 (out of a maximum of 6). The mean for the control questions was 3.0 (out of a maximum of 4). Paired t-tests indicated that the means between the socially-proximate condition and distanced condition were significantly different, $p < .05$. There were no significant differences between the socially distanced cold condition and the control questions, $p > 0.41$.

At the end of each vignette, we asked the participant if they thought the healthy child would contract the common cold virus from the sick child and if so to justify their responses as part of the experimental task. Examples of some explanations in which preschoolers provided for why the healthy child would not contract the common cold from the symptomatic situation, was "Cause he's staying away, he is far away so won't get the germs", "he is not coming in contact with is friend's germs'.

3.3 Discussion

The goal of this study was to serve as a control to demonstrate preschoolers' understanding of socially proximate versus social distancing and if preschoolers recognize that social distancing leads to a decrease in the level of contamination of a contagious illness like the common cold. The results of this study demonstrate that preschoolers recognize that social distancing leads to a decrease in the level of transmission of the common cold and that with increased proximity, they are likely to contract the common cold. There was no significant difference between the

cold condition and the non-contagious ailments condition indicating that preschoolers recognize that social distancing makes a difference in the transmission of contagious illnesses. This suggests that preschoolers make the distinction between contagious and non-contagious illnesses and also take proximity into consideration when making decisions about the transmissibility of the illness/ailment.

4. General Discussion

The present set of studies demonstrates that young children (4 and 5 years of age) have an overall solid understanding of the transmission of the COVID-19 in multiple conditions. Study 1 demonstrated that there is no statistically significant difference between preschoolers' understanding of the transmission of COVID-19 when an individual is symptomatic versus asymptomatic when they are close by. On the other hand, the results did demonstrate that the preschoolers had an overall understanding of how contagious the virus is even when symptoms are not present. Study 2 used the symptomatic common cold virus with and without social distancing to show that preschool aged children understand that the common cold is contagious as well as displaying their basic understanding of the role social distancing and how that plays into increasing or decreasing the transmission of the common cold. These findings are consistent with the suggestion that preschoolers have an autonomous and coherent theory of biology (Kalish, 1996; Springer & Ruckel, 1992).

One of the prominent findings in Study 1 is the fact that preschoolers recognized the transmission of the virus even though it was asymptomatic. The question this raises is why is this the case? One possibility could have been that preschoolers were falling back on information that adults had given them that would influence their responses. In both the COVID-19 symptomatic and asymptomatic without social distancing conditions, it was mentioned that the healthy individual would get sick if they do not wash their hands, not wear a mask, or if they stand too close to the contagious individual. Thus the mention of someone having COVID in the asymptomatic condition in Study 1 along with the proximity factor might have prompted them to reason that COVID will be transmitted even in the asymptomatic condition. This is supported by Kalish (1996), who states that from one perspective children's understanding of biology is just how they reason about content that adults identify as biological.

Study 2 demonstrated that with contagious illnesses, preschoolers clearly factor in proximity as being responsible for the transmission of a contagious illness like the common cold.

The findings of these studies extend the findings of DeJesus, Venkatesh and Kinzler (2021) where not only did the preschoolers take proximity into account when reasoning about the transmission of the cold virus but they could also recognize that even in asymptomatic conditions, the COVID-19 virus can be spread.

As with all studies, there were limitations that need to be addressed within this experiment. First of all, the sample was primarily middle-class Caucasian children limiting the generalizability of this study. Second, this study only examined preschool populations. Third, these studies only explored a couple of aspects of COVID-19 transmission – the symptoms and the proximity factor. Other factors such children's understanding of masking, the impact of vaccines in the transmission of Covid, etc. need to be studied.

Future studies can test other age groups to see if their thinking about the transmission of the COVID-19 virus is different from the preschool population. This could be done using younger preschoolers (3 years old), elementary aged students, high school students, college students, or even adults. This would present a developmental perspective of children's understanding of the COVID-19 virus.

In conclusion, the findings of these studies are a first step in demonstrating preschoolers' recognition of the mechanisms of how the COVID-19 virus is spread. Clearly, these results indicate that preschoolers have an autonomous and sophisticated theory of biology when reasoning about the spread of the COVID-19 virus in the preschool years.

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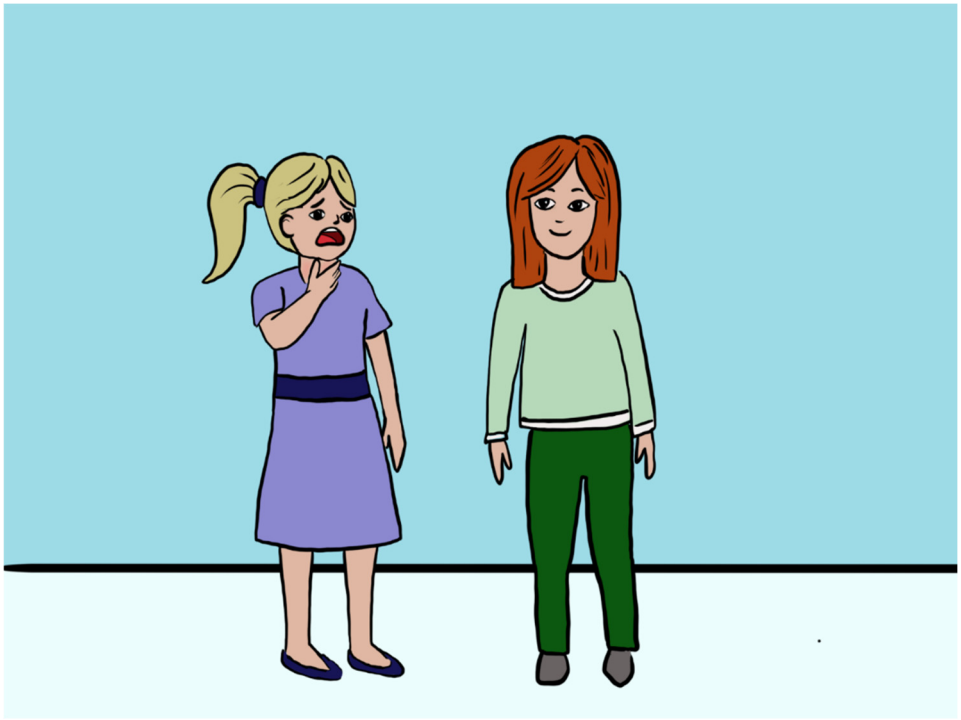
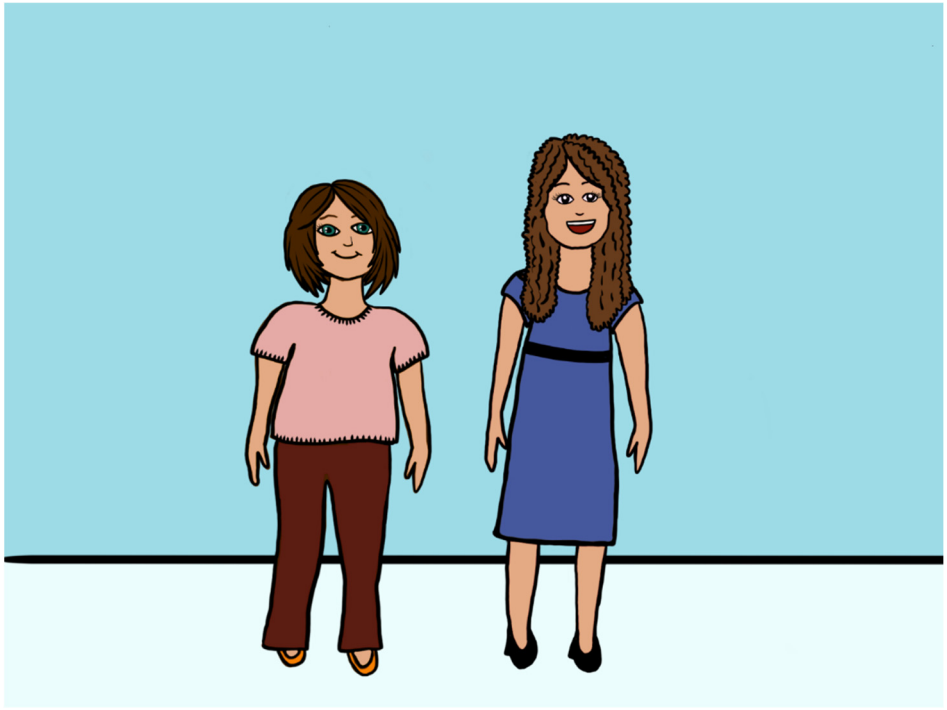
Study 1. Symptomatic without social distancing



Study 2. Asymptomatic without social distancing



Study 2. Cold symptomatic with social proximity

Study 2. Cold symptomatic with social distancing