

Reading Through Gaming in Primary School – A Pilot Study

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Abstract

Game-based learning is adapted in many classrooms across the globe. Researchers have found a positive impact in incorporating games in classrooms, with a growing trend in studying the implication and effectiveness of boardgames on reading comprehension. However, few focus on the difference in reading performance during gameplay among individuals. The question we ask is “if we know that games facilitate learning, which game is appropriately challenging?”.

“Reading Through Gaming in Primary School” aims to identify features of boardgames that can predict its reading difficulty. We attempt to create a formula so that laymen can use it to grade boardgames and choose the appropriate game that balances entertainment and learning.

In this pilot study, we have established a positive correlation between participants’ reading level and their reading accuracy during gameplay. 72 students aged 5 to 8 years old (Year 1 to Year 3) from a local UK primary school participated in this study, 114 running records were collected. Four out of seven games were found to have a strong correlation ($r > +.5$, $p < .05$). However, more data is required to draw a conclusion.

The next steps for this project are i) collecting more data from a larger population and ii) running a regression model to establish a scale when the sample size is sufficient.

Keywords: boardgame, reading level, game-based learning (GBT), correlation

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Introduction

Game-based learning (GBL) is a popular field of study. Studies have shown that GBL effectively enhances students' language acquisition and reading comprehension by engaging their attention and nurturing their interest (Ghazy et al., 2021; Rakimahwati & Roza, 2020; Sinaga, 2018). In general, this approach is effective in "facilitating students' 21st century skill development" (Qian & Clark, 2016).

A huge variety of games can be used in education, ranging from role plays to online speed-games. In this study, we focus on boardgames and students' reading comprehension. Hawkinson (2014) studied how boardgames implement specific learning goals. The physical presence of boardgame and other players provides an advantageous environment for learning goals that revolve around language, communication and team building. Furthermore, the game experience can be interpreted by both the players and teachers. The collective effort in creating and driving the storyline of the game makes the experience thematic and emotionally charged. "The relationship between board gameplay and learning is evidenced across disciplines and countries" (Bayeck, 2020), however, how do we identify the appropriate games for students with different reading ability?

Hatcher (2000) created a formula that can be used by teachers to grade children's early reading books. He identified 5 variables that predicts a unique book level variance -- the number of words in the longest sentence, number of words comprising six or more letters, syntactic features, number of pages in the book, and the number of words in the book. The application of the formula does not limit to children's book. Our research team has previously worked on adapting the Grading System to suit websites by adjusting the exclusion criteria and identifying suitable alternatives. With the foundation built from previous attempts, we hope to extend our findings to boardgames.

The current rating on boardgames is mostly based on the complexity and appropriateness of the gameplay, rather than its reading difficulty. Studies on boardgames and reading are concentrated on its implications and effectiveness. Noticing the research gap, we aim to identify variables that predict a boardgame's reading difficulty and match it with reading scales that school use (e.g., the Oxford Reading Tree). Due to time constraints, this pilot study focuses on establishing a positive correlation between participants' reading level and their reading accuracy in gameplay.

Methodology

Participants

The sample included all students aged 5-8 in Years 1 to 3 at a UK primary school, excluding two students in Year 2 who, according to their teacher, would not read aloud. This resulted in a final sample of 72 participants. The participants played board games in groups of 2 to 6, depending on the game's requirements (M=4). A total of 7 games were used and 114 running records were collected.

Table 1

Distribution of Reading Level (Appendix A: Reading Level Scale Comparison)

Coded Reading Level	No. of Participants (N=72)
Level 1	1
Level 2	1
Level 3	6
Level 4	1
Level 5	7
Level 6	0
Level 7	9
Level 8	18
Level 9	7
Level 10	6
Level 11	0
Level 12	2
Level 13	2
Unknown/uncertain*	12

*The reading levels have to be double-checked with the school.

Table 2

Number of running records for each game

Game	No. of Running Records
BrainBox: Animals	18

Cluedo	18
5 Second Rule	16
Monopoly Junior Game: Peppa Pig Edition	16
Junior Colour Brain	16
Unstable Unicorns for Kids	15
Monopoly Junior - Level 1	15

Procedure & Materials

Preparation

Two weeks prior to visiting the school, researchers ($N=3$) used the Hatcher reading scale to rate 68 children's books, ranging from picture books to young adult fiction, cross-checking the rating between themselves and with their supervisors' database. The researchers also used an adapted version to rate websites.

Researchers played various board games chosen by their supervisor. Games selected to take into schools were played by the team at least once. The team then selected 7 games suitable to take into schools, with 2-3 fall back options. The games were selected and allocated a general year group suitability according to the estimated reading level of each game. Researchers were then trained and practiced taking reading records, whilst playing games and watching YouTube videos of children reading.

To prepare the games for running records, researchers decided which reading components to exclude and labelled the chosen reading components with numerical and/or alphabetical codes (card/ board section). In addition to this, some of the games were typed up on Microsoft word for ease in following.

Exclusion criteria	Operational definition and Reasoning
Measurement units in abbreviation form	Measurement units presented in its abbreviation form will not be counted as participants' reading level cannot be evaluated.
Flavour text	Flavour text is text on a card that will not affect the gameplay if the participants ignore it. Since it is not necessary to read, it is not counted.

Data Collection

The research took place in the school library, which was situated between the KS1 classrooms and the main hall (where lunch and indoor sports took place). It was usually a quiet place with minimal distractions, but occasionally students would walk through, or a particularly noisy activity would take place in the hall. Researchers made attempts to redirect participants' attention; nonetheless, the distractions were found to have insignificant impact.

On average, each group would play a board game for 30 minutes. One researcher was the dedicated "teacher" who will teach the participants how to play the game and assist them throughout. The other two researchers completed the running records, each taking half of the participants. To maintain consistency, the researcher not assigned to a particular participant at any given time still monitored the reading process, ensuring they concurred with the running record of that participant. Any unresolved disagreements were referred to the researcher instructing the game, as they were in closer proximity to the participant and therefore more likely to have accurately heard what was said. The teaching researcher read the labelled number aloud before each participant began reading to assist the running record process.

To select suitable games for each group, we considered factors like game complexity, reading difficulty and the required background knowledge. Participants were grouped in small groups of 2-6, matched by similar reading levels where possible. The allocation of games was pre-decided, however, after observing the initial groups, adjustments were made (**Appendix C: Pre-decided Game Distribution and Alterations**). Our goal was to collect data across different years and reading levels for each game. The gameplay of certain games was modified to make them suitable for school settings and to maximize the sample of words (**Appendix B: Gameplay Adjustments**).

Ethics

The ethics of this research has been approved by the Faculty Research Ethics Committee (FREC) of the University of Leeds (Reference number: 1640). Prior to the study, detailed information of the project was sent to Year 1-3 parents, outlining the nature and objectives of the research. Consent forms were signed by the participants after researchers thoroughly explained the

research and the meaning of the form. All participants signed the consent forms to confirm their understanding and willingness to participate.

Initially, the forms were signed upon arrival before the games, but this process was found to be time-consuming. As a result, verbal consent was obtained before participation, with the forms completed and signed afterward during debriefing by the researchers. It was clearly communicated to the participants that their participation was entirely voluntary, and they could withdraw from the study at any time and return to their class without any negative consequences.

Overall, the participants demonstrated a high level of engagement and positive attitude towards the games. There was one participant who lost interest and was promptly allowed to return to their regular classroom activities. Instances of negative reactions, typically stemming from teammates losing points were rare, and several teachers noted their surprise at how well the participants handled losing. Occasional conflicts arose within teams, particularly during the game Junior Colour Brain, when participants disagreed on which card to play. To resolve this, the participants were instructed to use methods like "eeny, meeny, miny, moe" to decide, which effectively helped teams reach a consensus.

To ensure confidentiality and anonymity, participants were given a numerical code which were used as identification in all records and data analysis.

Results

The reading accuracy and accuracy category is collected. A positive correlation ($r > .5$, $p < .05$) between the participants' reading level and reading accuracy was observed in 4 out of 7 games.

Variable	Operational Definition
Reading Accuracy (Accuracy)	Total number of words read correctly divided by the total number of words read (correct or self-corrected + incorrect).
Accuracy Category (Category)	Category 1: reading accuracy $\geq 95\%$ Category 2: reading accuracy between 90% -94.9% Category 3: reading accuracy $< 90\%$

Note. Students achieving above 95% in reading accuracy implies that they have mastered text in that reading level; while 90%-94% is an instructional level, meaning that students find the text challenging without feeling overwhelmed (Burns et al., 2015).

Exclusion criteria	Reasoning
Sample with less than 20 words	One mistake will result in more than 5% decrease in reading accuracy, significantly affecting the accuracy category.
Participants with discrepancy in reading level	Some participants' reading level did not fit into the reading scale, hence cannot be numerically coded.
Second attempts	Some participants played a game twice, their second attempt will not be counted to ensure consistency.

Table 3

Correlation table between reading level and reading accuracy

		Reading Level	
Monopoly Jr.: Peppa Pig	Accuracy	Pearsons's r	+.592*
		df	13
		p-value	.020
	Category	Pearsons's r	-.519*
		df	13
		p-value	.047
BrainBox: Animals	Accuracy	Pearsons's r	-.112
		df	15
		p-value	.668
	Category	Pearsons's r	+.090
		df	15
		p-value	.733
Junior Colour Brain	Accuracy	Pearsons's r	+.938*
		df	3
		p-value	.019

	Category	Pearsons's r	-.685
		df	3
		p-value	.202
Unstable Unicorns for Kids	Accuracy	Pearsons's r	+.021
		df	13
		p-value	.940
	Category	Pearsons's r	-.141
		df	13
		p-value	.616
Cluedo	Accuracy	Pearsons's r	+.307
		df	14
		p-value	.247
	Category	Pearsons's r	+.148
		df	14
		p-value	.585
5 Second Rule	Accuracy	Pearsons's r	+.943*
		df	8
		p-value	<.001
	Category	Pearsons's r	-.742*
		df	8
		p-value	.014
Monopoly Jr. - Level 1	Accuracy	Pearsons's r	+.898*
		df	13
		p-value	<.001
	Category	Pearsons's r	-.688*
		df	13
		p-value	.005

* $r > \pm .5$ and $p < .05$

A Pearson Correlation examined the relationship between the reading level of the participant and their reading accuracy. Reading accuracy is the total number of words read correctly divided by the total number of words read (Khor et al., 2014). A perfect correlation was observed in 5

Second Rule ($r(8) = +.943, p < .001$) and Junior Colour Brain ($r(3) = +.938, p < .05$). A very strong correlation was observed in Monopoly Junior - Level 1 ($r(13) = +.898, p < .001$). A strong correlation was observed in Monopoly Junior Peppa Pig ($r(13) = +.592, p < .05$). No statistically significant correlation was found in BrainBox: Animals ($r(15) = -.112, p = .668$), Unstable Unicorns for Kids ($r(13) = +.021, p = .940$) and Cluedo ($r(14) = +.307, p = .247$).

Discussion

Due to the study's limitation, it is too early to conclude the correlational relationship between reading level and reading accuracy in this pilot study. It should also be reminded that the sample size for a few games is exceptionally small after exclusion. However, the study highlighted that variations in reading levels affect players' reading accuracy during gameplay, indicating the potential for future research.

We observed that games with strong positive correlation are more consistent in terms of the vocabulary difficulty each player will come across within and among gameplays. On the other hand, games with statistically insignificant correlation have cards with a larger variety of difficulty. The players' performance is affected by the card they have randomly picked, as well as how familiar they are with the content. Nevertheless, more data should be collected to obtain a bigger picture.

External Variables to Consider

It is important to note the external variables that influenced participants' reading performance. The place of the study was near the classrooms and the main hall with occasional disruptions, such as noise from students heading to lunch or sports activities. Researchers also notice that a few factors arose affecting the reading process itself. Firstly, the participants' eagerness to engage with the game sometimes led them to read too quickly, resulting in missed words or even full sentences. Secondly, despite repeated reminders, other players frequently read out words for their peers, inadvertently providing hints that sometimes disrupted the reading process. Thirdly, participants' hesitation often resulted in mumbling, making it challenging to determine the accuracy of their pronunciation. Furthermore, slight discrepancies in pronunciation among

researchers may have affected the accuracy of reading assessments. In these cases, the majority opinion was used to make final decisions.

Limitations

This study has several limitations. The representativeness of the study is limited. Convenience and quota sampling method were used; hence the sample is highly subjected to research biases. Participants were also limited to a specific age group at a single primary school. The impact of cultural, social and economic factors was not included. The sample size is also small, with each game having less than 20 samples after exclusion. Other factors like player sequence, preference for games and the presence of researchers might also influence the performance of the participant.

Suggestions

1. Typing up the games

The type-up of games facilitated running records significantly, especially for games with long paragraphs like Cluedo and BrainBox: Animals. Researchers can follow closely what the participant has read, avoiding confusion or misunderstanding. We have typed the content of each card and linked them to their respective numerical and/or alphabetic code. While running the record, researchers can quickly refer to the content by pressing the code of the card on the PDF.

2. Handling administrative details before fieldwork

We have spent a lot of time going through the consent form with the participants; some struggled to understand and we had to ask them to re-do it. It would be most ideal if consent forms were filled out prior to the fieldwork. This will streamline the process and ensure all necessary permissions are in place.

The collection of participants' reading level was also challenging. While some brought their books with reading levels printed, many were uncertain of their own levels and the school's record was incomplete. By obtaining the reading level before fieldwork, researchers can better organize groups and select appropriate games for participants with specific reading levels.

3. Implement voice recording during gameplay

Due to ethics considerations, we did not record any gameplay sessions for this study. However, if possible, voice recordings will be helpful to solve discrepancies between researchers. The flow of the game sessions was considerably quick, a small hiccup can impact the running record

significantly. Hence, researchers had to make decisions in split seconds, leading to conflicts and potential mistakes. We believe that conflicts like accent, pronunciation difference and the identification of “self-correction” can be reviewed through recordings. This will provide a reliable reference, ensuring that important details are not missed.

To ensure consistency, researchers should be mindful of the word count discrepancy among players. It is essential for them to maintain a flexible approach and be willing to make adjustments or modifications to the gameplay based on the participants' proficiency levels and the experimental setting. When involving different games and repeated players, the organization of each participant's profile is especially important. Researchers should take extra care on the administrative aspect of the experiment.

Conclusion

This pilot study established a positive correlation between participants' reading level and their reading accuracy during gameplay. 72 students aged 5 to 8 years old (Year 1 to Year 3) from a local UK primary school participated in this study, 114 running records were collected. Four out of seven games were found to have strong correlation ($r > +.5$, $p < .05$). However, as the sample size of this study is small and highly subjected to sample bias, more data should be collected before drawing a conclusion.

We have established a working flow and framework in this pilot study which can be used as reference for future research. Our team intends to procure further data from primary schools, secondary schools, libraries, and other pertinent institutions. When the sample size is sufficient, we will run a regression model to identify boardgame features that predicts its reading difficulty.

Personal Reflection

I feel incredibly fortunate to be chosen as a Laidlaw Scholar and to be part of this exceptional research team at the University of Leeds. The 6-weeks summer research has taught me so much that can never be learnt from books. I've learnt how to make small talk, how to not use an umbrella when it's raining and how many Harry Potter shops there are across the country. Research is something alien to me, and there are so many moments that I was completely clueless or thought I could never solve the problem. But looking back, those barriers seemed so small. I realized that fear itself is the biggest fear we can ever have. These monsters look huge, but if we are willing to step closer and try fighting back, we will notice how much potential we carry.

Going to the UK alone was a challenge, and leading a research project, from design to report writing, is even bigger. In fact, it still feels like a dream to me. I am certain that this experience will be a part of me. You will find pieces of the people, the landscape and every insignificant moment I have had in the past six weeks in me.

I am proud to say that I have become a better version of myself. Perhaps not smarter, but more resilient, open-minded and independent. And of course, more experienced in stair-climbing (our office was situated at the top level of the building and the stairs were terrible to climb).

Acknowledgements

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Not to forget the support from the Laidlaw team at both the University of Hong Kong and University of Leeds. Thank you for putting in so much effort and time to make everything possible.

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Appendix A: Reading Level Scale Comparison

The school used various reading level scales. Year 1 used the Read Write Inc. scale; while Year 2 and 3 used the Oxford Reading Tree scale. By comparing the description of each reading level between scales, we have created a comparison chart and used a code as a universal representation of a participant's reading level.

Read Write Inc.	Oxford Reading Tree	Coded Reading Level
Purple	BELOW (lilac/pink)	1
Pink	Red	2
Orange	Yellow	3
Yellow	(Light) Blue	4
Blue	Green	5
	Orange	6
Grey	Turquoise	7
	Purple	8
	Gold	9
	White	10
	Lime	11
	Brown	12
	Grey	13
	Dark Blue	14
	Dark Red	15

Appendix B: Gameplay Adjustments

Game name	Game Synopsis	Gameplay Adjustments
Cluedo	Cluedo is a murder mystery game where players must deduce which suspect committed the crime, with what weapon, and in which room. The game involves moving around a mansion by rolling some dice that are numbered 2-6 and the final side of the dice results in players picking up “Cluedo cards”. Players read Cluedo cards to gather clues and eliminate possibilities. The first player to correctly solve the mystery wins the game.	The game was played by three groups of six Year 3 students. The first group followed the standard rules, but it became evident that the word count was too low, and the game duration was too long (over 30 minutes). For the subsequent groups, adjustments were made: each player picked up a "Cluedo card" on their turn, which increased the word count and reduced the game duration to 15-20 minutes. Additionally, the first group exhibited confusion between the character figures and character cards. To address this, we used colored counters from another game as the moving pieces, while the original figures were placed in rooms as per the written guidelines.
BrainBox: Animals	BrainBox: Animals is a memory game where players read an animal-themed card for 10 seconds. The card contains details about the animal’s habitat, diet, and characteristics. After rolling the dice, they read a question on the other side of the card and answer based on the given information. Players compete to collect the most cards by recalling facts accurately.	The game was played by three groups of six Year 3 students. All three games were modified into a competitive format with no teams. Each player took turns reading their card’s information aloud for everyone to hear, then placed the card in the middle of the table for all players to silently read for 10 seconds. After rolling the dice, the same player read the question aloud, and all other players (except the reader) answered. Players kept the cards they answered correctly, earning one point per card. If no one answered correctly, the dice was rerolled until a new number appeared, prompting another question to be read and answered in the same manner until a correct answer was given.
Junior Colour Brain	Junior Colour Brain is a quiz game where each player or team starts with 11 colour cards and a colour capture steal card. A question describing a person or thing is read	The game was played by four groups of Year 1 students: three groups of four students and one group of three students. In the groups of 4, players were paired up to form a team. One will read the question,

	<p>from the main deck, and players choose the matching colour card(s) from their set to answer. The colour capture card allows a team to steal 8 colour cards from the leading team, making it more challenging for them to answer the next question. The objective is to correctly match colours to questions and be the first to collect 10.</p>	<p>and another will answer. The team with more correct answer wins.</p> <p>In the three-person group, players will take turn to read the card, while the other two players will answer. Colour capture cards were not included to make the gameplay simpler and more accessible.</p>
Unstable Unicorns for Kids	<p>Unstable Unicorns for Kids is a strategic card game where players build a stable of up to 7 unicorns by drawing and playing cards. Players read and follow the instructions on cards they play, which may involve gaining unicorns, sabotaging opponents, or using special abilities. The goal is to be the first to collect 7 unicorns in the stable while navigating various twists and challenges introduced by the cards.</p>	<p>The game was played by two groups of Year 2 students (one group of six and one group of four) and one group of Year 3 students (a group of five). In the first game, players were only required to read aloud the cards they played. However, to increase the word sample, they were asked to read the cards they “discarded” in the subsequent two games. Some cards contained repeated main body text; if players noticed this and chose not to re-read the card, they were allowed to skip it. Conversely, if they did not notice and read the card again, we did not intervene.</p>
5 Second Rule	<p>In 5 Second Rule, players draw a card, read the prompts and must quickly name three items that fit the category within five seconds. Each correct answer earns a point and allows players to advance along the board. The goal is to move the furthest by answering quickly and accurately to win the game.</p>	<p>The game was played by four groups of Year 2 students: three groups of four and one group of three. It was modified into a team game with a 10-second time limit. In this format, one student read the card aloud while their teammate had to answer. If they couldn't answer, the next team had a chance.</p>
Monopoly Junior - Level 1 & Monopoly Junior Game: Peppa Pig Edition	<p>In Monopoly Junior - Level 1 and Monopoly Junior Game: Peppa Pig Edition, players start by selecting a character and reading their character card, including information such as the characters job, hobbies etc. Player's roll the dice to move around the board, reading property names and</p>	<p>No adjustments were made.</p> <p>Monopoly Junior - Level 1 was played by four groups of Year 1 students: one group of five, two groups of four and one group of two.</p> <p>Monopoly Junior Game: Peppa Pig Edition was played by three groups of</p>

	purchasing them. Players also read and follow instructions on Chance cards.	Year 1 students and one group of Year 2, with four players per group.
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Appendix C: Pre-decided Game Distribution and Alterations

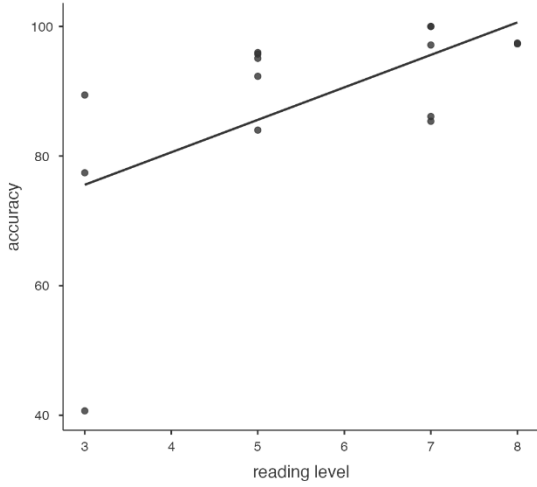
After playing the games, researchers convene to determine the most appropriate game for each grade level of students. Considerations include vocabulary difficulty, gameplay difficulty and the knowledge barrier of the game. The following table lists the initial game distribution and the alterations we have made after observations.

Game	Pre-decided Year, Reason and Observation	Alterations (if any)
Cluedo	Year 3 Cluedo is a murder mystery game which requires players to eliminate the potential culprit. We find that the concept of “elimination” was quite confusing for some Year 3 students. The vocabulary on the Cluedo Card also consists of rare or long words (e.g., conservatory, billiard, revealed, dagger). We’ve made the decision based on the gameplay and vocabulary difficulty.	N/A
BrainBox: Animals	Year 3 BrainBox: Animals is a memory game which requires players to memorize information in a short period of time and answer questions. Players need a foundational knowledge of geography and animal-related terms in order to enjoy the game. The vocabulary also consists of rare or long words (e.g., stallion, eucalyptus, Himalayas). Some Year 3 students struggled with the reading. We’ve made the decision based on the knowledge barrier and vocabulary difficulty.	N/A
Unstable Unicorns for Kids	Year 3 Unstable Unicorns for Kids is a card-collecting game which players have to collect a certain number of unicorns to win. The vocabulary on the card is modestly difficult, with similar wordings across different cards. However, we found the gameplay challenging as there are multiple “magic cards” which perform different functions and would take huge effort for players to understand.	Year 2 After a round with Year 3, we discovered that they could read the vocabulary at ease. We decided to invite a group of Year 2 with higher reading level to try it, and the result is similar. Hence, we adjusted the game distribution and assigned more higher-level

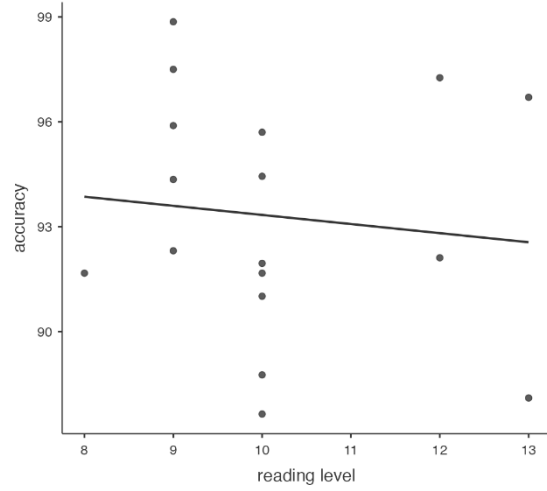
		Year 2 to play instead of Year 3.
5 Second Rule	Year 2 5 Second Rule is a speed game in which players have to answer the question in a limited time. Since the game involves a wide range of questions, from TV show characters to geography and history, players need a basic general knowledge of the world. We've made the decision based on the knowledge barrier.	N/A
Monopoly Junior Game: Peppa Pig Edition	Year 1 Monopoly Junior Game: Peppa Pig Edition is a buying-and-selling game. Most words come from the character card and "Chance" card. The gameplay is straightforward, and many participants have experience with it. The words are also relatively simple as it is the junior version. We've made the decision based on the gameplay and vocabulary difficulty.	Year 1 & 2 After several rounds of playing with Year 1, we see players with lower reading level struggle slightly. To obtain a full picture, we decided to play a round with lower-level Year 2.
Junior Colour Brain	Year 1 Junior Colour Brain is a matching game in which players have to choose a colour that matches the description of the card. The words on the card are relatively easy or commonly seen in daily life. Since most participants are local students, the influence of cultural differences on the comprehension of the words is minimal. We've made the decision based on the gameplay and vocabulary difficulty.	N/A
Monopoly Junior - Level 1	Year 1 Monopoly Junior - Level 1 is a buying-and-selling game. Most words come from the character card and "Chance" card. The gameplay is straightforward, and many participants have experience with it. The words are also relatively simple as it is the junior version. We've made the decision based on the gameplay and vocabulary difficulty.	N/A

Appendix D: Scatterplots

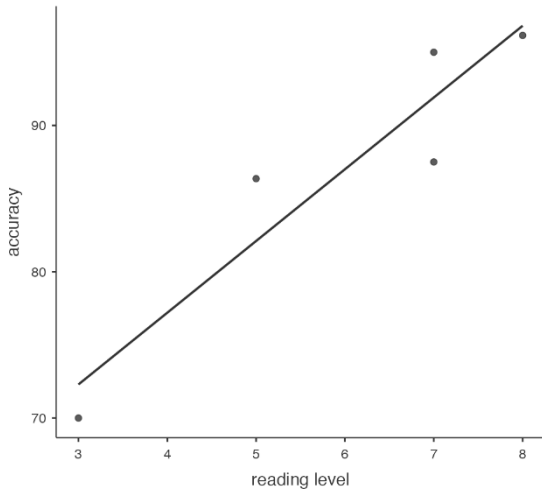
Monopoly Junior Game: Peppa Pig Edition



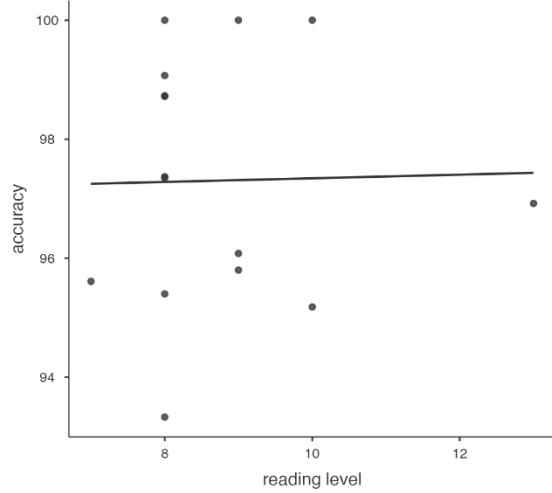
BrainBox: Animals



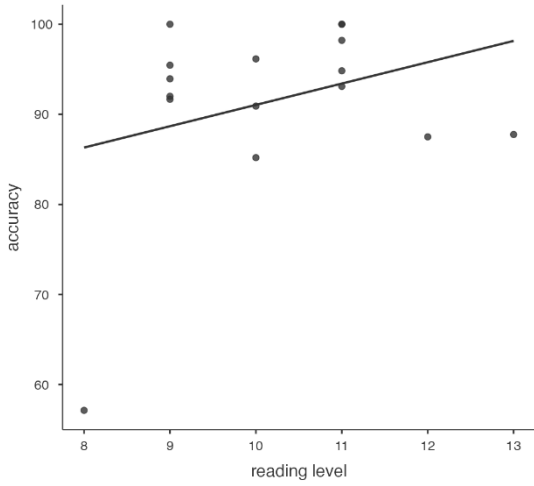
Junior Colour Brain



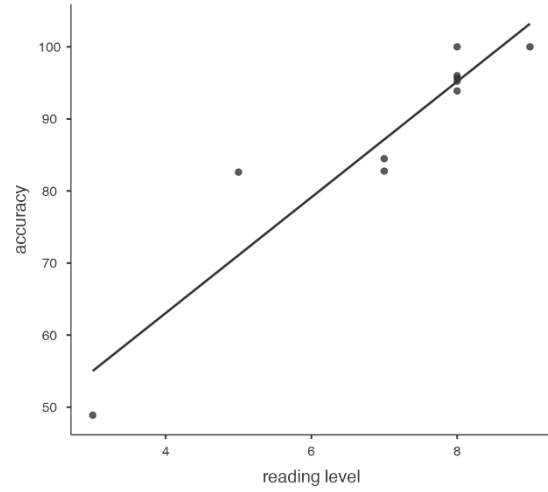
Unstable Unicorns for Kids



Cluedo



5 Second Rule



Monopoly Junior - Level 1

