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Gender stereotypes: an analysis of Python programming books for children in the Netherlands.

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Abstract

Women are underrepresented in the field of Computer Science and stereotypes are one of the most important causes. Textbooks for children include illustrations that might maintain these stereotypes, since they represent today's society. Gender stereotypes in the illustrations can demonstrate in various forms, including role models, use of colour, and (gendered) attributes and objects. In this thesis four Python programming books targeted to Dutch children aged nine to fourteen were analysed to get an insight into the visual gender stereotypes that appear in these books. Every book was found to display different kinds of gender stereotypes. Men are displayed more often in illustrations than women and they are active more often. Furthermore, ethnicities such as black, Asian, and multiple ethnicities/other ethnicities are underrepresented. There were no clear stereotypes found in the use of colour. In addition, gendered objects in general do not have typical colours that are associated with or marketed towards boys, such as blue and other bold colours. Nevertheless, there are no male gendered objects in the colour pink in any of the books. In addition, the majority of the gendered objects and attributes has a masculine connotation. The majority of the objects and attributes, however, is not gendered.

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1 Introduction

The Netherlands stands in third place on the Gender Equality Index of the European Union [1]. This index is a measure that the European Union uses to determine the progress of gender equality in a country [2] by studying how factors such as level of education and age in combination with someone's gender influence their life [3]. Since the Netherlands scores high in this index, one could expect that the progress of gender equality in general in this country is good in comparison to other countries in the European Union. However, this is not the case for every part of society in the Netherlands. There is a low representation of women in the field of Computer Science.

Women choose not to study or work in Computer Science for multiple reasons. Firstly, girls do not have much interest in the field and they expect that they will not fit in [4, 5]. Secondly, a lack of female role models influences the number of women in the field, and thirdly, self-efficacy contributes as well [6, 7]. Self-efficacy in relation to Computer Science describes the belief that a person has in and being able to perform the tasks that come with being a computer scientist and fitting in. When the self-efficacy of a person is low, they are not likely to enter the field.

All the previously mentioned reasons are influenced by stereotypes, which is the last reason for women to avoid studying or working in Computer science [5, 8]. When girls think about Computer Science, they will often have a stereotypical computer scientist in mind. This is someone who is male, has low social skills and is geeky. Additionally, this person has a great interest in computers and technology, likes to play video games and is highly intelligent [12, 13, 14]. Research has shown that non-stereotypical role models are an effective way of interesting girls in Computer Science. A non-stereotypical role model will increase the belief of girls and women that they belong in the field, which will make them more likely to pursue a job in the field [9, 10]. In addition, women will have a feeling of being able to have a chance of succeeding as a Computer Scientist. Thus, their self-efficacy and belief of fitting in improves by staying away from stereotypes as much as possible and introducing non-stereotypical role models. The increase in self-efficacy establishes even after a short interaction [11].

Gender stereotypes influence inequalities between men and women, because they shape gender roles for the rest of people's lives [15]. Typically, they are formed at an early age. Therefore, to ensure that gender stereotypes are not represented in someone's life, these stereotypes should be changed from a very young age as well. An example of where these stereotypes make an entrance into people's lives from an early age on, is in textbooks. Textbooks play a part in forming gender roles and the (gender) identities of most people, since textbooks represent society and its values [14, 16]. Thus, by explicitly representing different cultures and by avoiding stereotypes, a real impact can be made [17].

Gender stereotypes are reflected in programming books by the display of the stereotypical computer scientist, gendered attributes, and role models [14, 17]. All these factors will be analysed in this thesis. In addition, use of colour might also have an effect, as textbooks for children are often colourful. In society pink is often considered a colour for girls and blue a colour for boys [18]. Thus, colour might influence whether a book is regarded as feminine or rather masculine. Therefore, this aspect will also be considered. Examples of assumptions about gender in books have been studied before, this will be discussed in Section 3: Background and Related Work. This thesis will

be an addition on this research, since there has not been a lot of research into this subject in the Netherlands and into this age group.

The focus of this thesis will be on how the factors (stereotypical) role models, gendered attributes, and use of colour, are represented visually in programming books that target children in the last four years of elementary school and the first two years of high school in the Netherlands. This will be analysed specifically in programming books for the programming language Python. Even though stereotypes are also reflected using gendered language, this will be outside the scope of this thesis. Thus, this thesis aims to get an overview of the occurrence of visual gender stereotypes in Python programming books for children and the role they will therefore have in sustaining the current gender stereotypes in Computer Science. Hence, the research question is:

Which visual gender stereotypes appear in Python programming books targeted to Dutch children from ages nine to fourteen?

The remaining of this thesis is organised as follows: Section 2 will contain some definitions for terms that are used throughout the thesis. Section 3 will elaborate more on related work that has already been conducted on this subject. This will include more information about diversity and stereotypes in Computer Science, self-efficacy in Computer Science, and colour in marketing and children's favourite colours. In addition, previous research into gender stereotypes in (programming) books will be discussed. Section 4 describes the method that is used for analysing the books and Section 5 reports the outcomes from the analysis. In Section 6 these outcomes are interpreted. Section 7 is the conclusion, and finally, in Section 8 the limitations of this analysis and the possibilities for further research are discussed.

2 Definitions

A *stereotype* is a simplified idea that is characteristic for a specific thing or type of person. This idea is maintained by many people and is recurring [19].

Self-efficacy describes the belief that a person has about their capabilities to successfully execute behaviour that one needs to achieve a wanted outcome [20].

Gender describes the physical and biological characteristics that make a person male or female.

Gender identity refers to how a person feels and experiences their gender. This can be male, female or something else, non-binary for example [21].

In this thesis gender stereotypes thus refer to the physical characteristics that define a person as male or female. However, it is important to note that gender is not binary and children can have a gender identity that does not match their gender. Therefore, they might relate to role models displayed in the book that are of a different gender.

3 Background and Related Work

3.1 Diversity and stereotypes in Computer Science

The lack of women in the Computer Science field is predominantly caused by stereotypes. The presence of stereotypes about programmers in the life of children has been shown clearly in a draw-a-programmer test. This test was done with students between the age of twelve and fourteen. When they were asked to draw programmers, 62.5% of the children only drew male programmers. When only taking female students into account, 75.3% drew at least one female programmer [22]. Different research has concluded that the Netherlands especially scored higher than any other country on maintaining gender stereotypes in Science, Technology, Engineering and Mathematics (STEM) in 2015 [23].

The stereotype of the typical computer scientist is not true in many cases. However, it still exists and influences the attitude of children towards programming and Computer Science. When children, specifically girls, do not feel similar to the stereotypical programmer, they underestimate their ability to be successful in the field [11]. Thus, it is especially important to make the field as diverse as possible for multiple reasons [8]. Firstly, the jobs in this field are often flexible and profitable. It is important that women benefit from these advantages as well. Secondly, our society does not only consist of people conforming to the stereotype of a computer scientist. However, they do design, test and build new technology that is used by everyone. Therefore, making the field more diverse, also positively affects the inclusivity of the technology. For example, currently the accuracy of automatically-generated captions on YouTube videos performs better on men than women [24]. This might improve when the technology is tested more on women. Thirdly, making the field more diverse does not only have a positive effect on women, but also on men. Research has shown that 25% - 30% of men prefer to work in a non-stereotypical environment [25]. Including more women into the field, will thus also attract more non-stereotypical men. This improves the diversity of the field even more.

3.2 Self-efficacy in Computer Science

In Computer Science a lack of self-efficacy relates to someone's unbelief of being able to perform the tasks that are expected from a computer scientist. Research shows that self-efficacy increases when students advance in a programming course [26]. Thus, when students do not believe that they are able to become a computer scientist at the beginning of a course, this will increase after they have finished the course. Therefore, it is important that programming books are also attractive to girls, because these books might result in an increase of the number of women that choose a career in computer science. When girls start a programming course or learn to program with the help of a programming book, their self-efficacy will increase, and this will make it more likely that they will choose a study and/or job in Computer Science later in life.

3.3 Colour in marketing and children's favourite colours

In society pink is often considered a colour for girls and blue a colour for boys. However, this does not necessarily influence the favourite colour of children [27]. Girls choose rather pink and purple shades as their favourite colour, compared to boys. However, both genders like the colour blue most often. In addition, blue was observed not to be a gendered colour, pink on the other hand was. Girls and boys both chose blue most commonly as their favourite colour, however boys almost never chose pink or purple shades. Moreover, boys will even start to actively avoid pink items [28]. Therefore, blue will not likely discourage a girl to buy a (mostly) blue programming book, but in contrast a (mostly) pink book can discourage a boy.

3.4 Previous research into gender stereotypes in (programming) books

Research similar to this thesis has been conducted. Even though every research used different methods, the overall results show that there are still gender stereotypes in textbooks about computer science and picture books for children [14, 17, 29]. This was indicated by the number of male characters in the books as opposed to the number of female characters, the attitude and emotions of characters, and their activities. Women are illustrated more rarely in textbooks. Additionally, the activities and actions of men in illustrations are more wide-ranging and varied. Male characters were also positive and competent, whereas women were often negative and incompetent.

First of all, Gooden and Gooden [30] researched gender representation in 83 picture books for children between 1995 and 1999. Even though this research was conducted in non-fiction books specifically, it shows that gender stereotypes prevail in various kinds of books for children. The gender of the main character, illustrations and the title of the book were analysed. This research was built upon previous research on the same topic. The main outcome was that there was an increase of female main characters and overall female representation as opposed to the older picture books. However, gender stereotypes were still widely displayed in the books. This analysis has been executed some time ago and therefore it can give some insight into how and if the display of gender stereotypes has changed over the years.

Secondly, a similar research was carried out more recently on picture books and graphic novels about Computer Science for K-8 students in the United States [31]. A K-8 is a school for children from five/six to fourteen years old and is therefore comparable to a Dutch elementary school. This paper not only focuses on gender stereotypes, but also on "people with diverse inter-sectional identities". For example, if the characters are of different ethnicities and abilities. It investigates what computer science practices the characters in the books are doing and what their gender and racial identities are. The findings are slightly different to previous research. In the books that were analysed, women were represented more than men (56%). However, people of colour were underrepresented and there were no adult males of colour displayed in the books.

Thirdly, the research conducted by Papadakis [15] examines gender stereotypes in computer science textbooks in Greece. This was carried out by including both text and illustrations in the analysis. One of the main outcomes was the use of masculine terms. Often a sentence like "pupils will thus

be able to” was used instead of ”male and female pupils will thus be able to”. In the Netherlands, these grammatical constructions are not always applicable. For example, the word ”programmeur” (programmer) can be used for both a male and female programmer. In general, this study showed that the books displayed stereotypical gender roles throughout the books. For example, the woman was often using the technology, whereas men were building and creating it.

Lastly, the United Nations Educational, Scientific and Cultural Organisation (UNESCO) wrote a methodological guide that aids in promoting gender equality in textbooks [14]. This guide shows, among other things, how gender representation already arises in textbooks and subsequently gives suggestions about how this can be averted. In addition, it gives tools that can be used to monitor gender representation in textbooks. An interesting result from an example analysis showed that almost every character could be labelled as male or female, since there were no neutral characters. Suggestions for promoting gender equality include monitoring not only stereotypes, but also every representation of any kind of gender and making the analysis as wide as possible.

4 Methods

4.1 Book selection

The books that are going to be analysed will be:

1. Programmeren voor kinderen - Python, written by Carol Vorderman for ages nine and older;
2. Programmeren met Python - ontdek de vele mogelijkheden in de wereld van het programmeren, written by Jason R. Briggs (Visual Studio Steps) for ages nine to twelve;
3. Programmeren met Python - Generation Code, written by Max Wainewright for ages ten and older;
4. Stap voor stap leren programmeren met Python, written by Studio Studio Visual Steps for ages ten to fourteen.

These books have been selected by searching for books on the website [bol.com](https://www.bol.com) in March 2022. The market share of bol.com is big in The Netherlands, thus many people would buy their programming book from this website. Additionally, when searching for programming books on Google the first advertisements that are shown are for programming books that can be bought on bol.com. All these factors collectively make it more likely that someone will buy their programming book on this website. By filtering on Dutch books for children about Python, five books remained. *Programmeren voor kinderen - Python Games* written by Carol Vorderman, is written for ages six/seven and older. This book is outside of the scope of this thesis, which focuses on books for children between the ages of nine and fourteen. Therefore, this book is an outlier and left out of the analysis.

The analysed books are all written for children from around the same age, therefore resulting in a more reliable comparison. Children in The Netherlands start elementary school when they are at the age of four and finish when they are twelve years old, after which the children go to high

school. Therefore, the books that will be analysed are used in the last four years of elementary school and the first one or two years of high school.

4.2 Book analysis

This analysis will focus on the visual aspects of the inside pages and cover pages of the book. Specifically, the visual gender stereotypes will be identified via the analysis of characters in illustrations, which will be discussed in Section 4.2.1; the use of colour on pages throughout the book, which will be discussed in Section 4.2.2; and the display of gendered attributes, which will be discussed in Section 4.2.3.

Every page that contains any of the listed visual aspects will be analysed. This also includes the cover page of the book. The cover page is important, since the books can be purchased by and for everyone. When people buy a book, they will take the cover page into account because it has to look attractive for the child that they are buying it for. Research has shown that people do, in fact, judge a book by its cover. An attractive book cover makes a person more interested in the book compared to other books, even though all other factors are the same. [32].

4.2.1 Characters

Every character that is illustrated in the book will be analysed. These characters can be existing or fictional people. Something is considered a character when it has facial features like a mouth or eyes. This means that characters entail humans, animals, but also objects that have facial features. Some characters are clearly a human or an animal, but their face might not be visible. These characters will also be considered a character. Anything else is considered an object and will be analysed in a later part of the analysis

Every time a reoccurring character is illustrated, it will be counted as a separate occurrence, even when it appears more than once on a page. Various aspects of every character will be taken into account by answering a number of questions that are based on the methodology suggested by UNESCO [14]. UNESCO suggests compiling a list of details about every character. These details can be categorised into the following groups: sex and age of the character; designations, such as name, relationships and occupational status; activities; attributes; and finally, interactions. Since details such as name and occupational status cannot always be determined by only looking at an illustration, this is not taken into account.

To obtain details about every character, the following questions are answered:

Is the character a human, an animal or something else (other)?

What is the ethnicity of the character? When a character is not human, this question will be answered with the colour of the animal/other. When the character is human there are four possibilities: Asian, black, white, and multiple ethnic groups/other. This categorisation is based on [33].

Does the character have a feminine or masculine appearance? When the appearance of a character cannot be determined, it is noted as neutral. For example, in general female characters have long hair and softer facial features whereas male characters have short hair and more shaped facial features.

What is the character wearing, what is the character's appearance? This includes the pieces of clothing, the colour of the clothing and any other gendered attributes like jewellery or a tie. Gendered attributes can be something the character is wearing, but also something it is holding. Objects that a character interacts with will not be analysed in this part of the analysis, as this will be taken into account in Section 4.2.3: (Gendered) objects. Moreover, the haircut and hair colour of a character will be taken into account and can be long (shoulder-length and longer), medium (chin-length) or short when the hair is loose and haircuts such as a ponytail or bun when the hair is not worn loose.

What is the role of the character in the book? It has to be taken into account if a character is a main character (more prominent) or rather a background character. For every character, it's role in the book and the role in society is considered. The role in the book can be major or minor. Major characters are characters that appear more often throughout the book and help the child that uses the book in some way. For example by helping them work their way through the book by helping with exercises or finding their way throughout the book by clarifying where information can be found. In addition to being major or minor character, their actual role is described. Examples are a guide or teacher, or when the character is not prominent it is considered a background character.

What is the character doing? A character will be considered active when it is actively doing something and passive when it is not (sitting or standing in place). When characters are interacting with each other, this is also noted.

What is the emotion of the character? The emotion will be categorised according to the basic emotions suggested by Paul Ekman [34]: fear, anger, joy, sadness, disgust, and surprise. In addition, confusion is also an emotion that a character can have. A character can also be categorised as neutral when no facial expressions or posture refer to any emotion.

Is the character an existing or fictional character? When a character is existing in real life it can be someone who is famous or not famous. When the character is someone who is known by the general public, an extra category for gender is considered. First the gender is observed by looking at the appearance of the character in the book. Then this is fact checked by searching for the gender identity of this person in real life.

Are there any other remarks that should be noted? Finally, there are always exceptions or other important things that should be noted, which will be done in the form of a small comment.

4.2.2 Colour

In society pink and pastel shades are often a colour considered for girls, whereas blue and other primary colours are considered more for boys [18]. However, Jonauskaite [27] has shown that both genders both choose blue as their favourite colour. Girls did choose rather pink and purple

shades more as their favourite colour, while boys rarely choose this colour as their favourite. In addition, Lobue and Deloache [28] have shown that pink is a gendered colour, but blue is not. Boys actively avoid pink items. Therefore, blue will not likely discourage a girl to buy a (mostly) blue programming book, but in contrast a (mostly) pink book can discourage a boy.

Not only the colour preferences of a child play a role in buying a book. In some cases, the child does not decide which book they want to buy, but a parent, guardian, or someone else does. The primary colours on the cover and inside the book also play a role in these situations. Research has shown that when a consumer decides to buy something for a boy or girl, gender-stereotypical colours are considered in the choice [35].

When considering the colours in the book it is important to take both the societal bias and the colour preferences of children into account. For every page, the most noticeable colours are noted. When looking at the most noticeable colour, characters and objects are not taken into account. Only colours of the whole page or background colours of text boxes are considered.

4.2.3 (Gendered) objects

Besides characters, objects can be present on a page in a book. Objects are only things that exist in real life. Thus, an illustration of something abstract is not considered an object. Additionally, objects that are screenshots of a computer screen will not be taken into account, since this is not an illustration or picture made by the author or illustrator of the book.

After every book and page is analysed, every object and attribute will be assigned a gender. Specific objects do not always have a label of being more for boys or for girls. However, an object can have a more masculine or more feminine connotation. The marketing of toys plays a part in what society considers more for boys or girls. This is shown clearly in the existence of masculine and feminine toys for children. Research has shown that girls have less interest in masculine toys in masculine colours than any other toys. Boys were more biased towards masculine toys than feminine toys [36]. The categories 'toys for boys' and 'toys for girls' will form a base for the labelling of the objects in the programming books.

Toys for boys often include things associated with sports, tools and vehicles. On the other hand, toys for girls are linked to dolls, furniture, domestic life and things that have to do with physical attractiveness [37]. Regarding colour, Auster and Mansbach have observed that the toys that are marketed towards boys had bold colours like red, black, brown, and grey. In contrast, toys for girls are often pink, purple, or any pastel shade [38].

A programming book that has many vehicles and tools throughout the book will subconsciously be considered more for boys. On the other hand, a book with a lot of dolls and furniture will be considered more for girls. It is important to keep in mind that these categorisations are not always proper. An example of a sport that can be considered more for girls is dance, and some furniture, a chair for example, is not gendered at all. Objects will be categorised according to the categorisations of toys, however these subtleties will be taken into account. Every object will be

listed and categorised as masculine or feminine. When an object does not have any obvious label, the object is categorised as neutral.

4.3 Data analysis

For every book, the data will be collected in a large table. The methodology suggested by UNESCO [14] is used as a base for obtaining an overview of details for every character. Every row contains a new character, every column gives the answer to one of the questions listed in Section 4.2.1. This methodology makes it possible to count every occurrence.

When every page is analysed and every (gendered) object and attribute has been assigned a gender, the data will be analysed. By counting the occurrences of different permutations of factors, an insight into the use of gender stereotypes in the books was obtained. For example, the total number of gendered attributes and the colours they have, the total number of male characters and the emotions they have, or the total number of female characters with a black ethnicity.

The results were gathered in multiple tables.

5 Results

5.1 Characters

5.1.1 Gender, emotion, and species of every character

Table 1 shows the distribution of gender, emotion, and species of every character in every book. When the character is human, the ethnicity of the character is also reported.

In the first book, *Programmeren voor kinderen - Python*, most characters are an animal or a human. The characters that are of the category 'other' are almost exclusively robots. Almost every human character has a neutral emotion; animals and others mainly have neutral and positive emotions. In general, positive emotions are joy. The majority of the human characters are white and no Asian characters are present in the entire book. The ethnicities of characters vary throughout the book. However, on the second page after the cover, there are fifteen human characters illustrated. Of these characters, nine are white, four have a multiple/other ethnicity, and only two characters have a black ethnicity. Both these two characters have a low-paying occupation: the first character is a construction worker, the second character is a criminal. The white characters have occupations such as cook, scientist, and computer scientist. Characters with a multiple/other ethnicity are, for example, a postal worker or tourist.

The second book, *Programmeren met Python - Studio Visual Steps*, almost exclusively features white, male characters. Most of these characters are displayed as joyous (positive). There are almost no characters that are female or have a black, Asian or multiple/other ethnicity in the book. There is only one exception: one black male.

gender	emotion	animal	other	human				total
				<i>black</i>	<i>white</i>	<i>Asian</i>	<i>multiple/other</i>	
<i>Programmeren voor kinderen - Python</i>								
neutral	positive	55	19	-	-	-	-	74
	negative	6	7	-	-	-	-	13
	neutral	93	17	-	1	-	-	111
	unknown	4	1	-	-	-	-	5
female	positive	5	-	-	-	-	-	5
	negative	-	-	-	2	-	-	2
	neutral	1	-	3	63	-	27	94
	unknown	-	-	-	13	-	2	15
male	positive	-	-	-	-	-	-	0
	negative	1	-	-	1	-	-	2
	neutral	1	5	19	60	-	27	112
	unknown	-	-	4	21	-	8	33

<i>Programmeren met Python - Studio Visual Steps</i>								
neutral	positive	28	32	-	1	-	-	61
	negative	4	4	-	-	-	-	8
	neutral	40	26	-	-	-	-	65
female		-	-	-	-	-	-	0
male	positive	-	1	1	19	-	-	21
	negative	-	1	-	-	-	-	1
	neutral	2	3	-	6	-	-	11

<i>Programmeren met Python - Generation Code</i>								
neutral	positive	-	-	-	-	-	-	0
	negative	5	-	-	-	-	-	5
	neutral	13	-	-	-	-	-	13
	unknown	21	-	-	-	-	3	24
female	positive	-	-	-	9	-	-	9
	negative	-	-	-	-	-	-	0
	neutral	-	-	-	-	-	-	0
male	positive	-	-	1	-	-	-	1
	negative	-	-	3	-	-	-	3
	neutral	-	-	7	-	-	-	7

<i>Stap voor stap leren programmeren met Python</i>								
neutral	positive	4	-	-	-	-	2	6
	negative	2	2	-	-	-	-	4
	neutral	2	-	-	-	-	-	2
female	-	-	-	-	-	-	-	0
male	-	-	-	-	-	-	-	0
total		287	117	38	196	0	69	

Table 1: Distribution of gender, emotion, species, and ethnicity of characters per book

In the third book, *Programmeren met Python - Generation Code* a combination of different computer science related animals is illustrated: snakes, turtles, and bugs. Snakes are related to the programming language Python; turtles are related to Python package Turtle, which can be used for painting; and coding errors in a programming language are called bugs. In addition, two characters are present. The first character is labelled as male; the second is labelled as female. The female character in the book could also be labelled as neutral, since this person does not wear stereotypical female clothes. However, due to the medium long hair, the label female was chosen. Most animals and others throughout the book have a neutral, negative or unknown emotion. The humans in the book are majorly positive. The only negative emotion depicted is by the male character and is confusion.

Finally, in *Stap voor stap leren programmeren met Python*, only the front and back cover of the book contained characters. The characters in the book all have a neutral gender and the emotions of the character are split between positive and negative emotions. The only negative emotion displayed by the characters is fear, whereas every positive emotion is joy. The front and back cover both feature every character once, so in total every character appears twice. The animals that are illustrated are a snail, snake, spider, dinosaur, and a mouse. Finally, there is one character in the category 'other', which is a computer where the screen served as a face. The one human character in the book has a yellow skin colour.

5.1.2 Gender, ethnicity, activity, role and interactions of every character

Table 2 is an addition on the previous table. Here, the connection between gender, ethnicity, and the role, activity, and interactions of characters is reported.

In *Programmeren voor kinderen - Python*, there are more passive than active characters present for almost every permutation. Every character in the book is a minor character and most interactions are between humans. There are more male characters throughout the book who interact with another character than female characters who do. The humans in the book are almost never illustrated more than once and are therefore all minor characters. Some animals reoccur throughout the book. These are all computer science related animals like snakes, which is related to the Python programming language; bugs, which are related to coding errors; and turtles, which is also a Python package for painting. However, these animals do not have a major role in helping the child that is using the book. Some characters from the category 'other' also reoccur, but these characters are also background characters. Therefore, in addition to the human characters, all animals and others are also minor characters.

The second book, *Programmeren met Python - Visual Studio Steps*, displays more active than passive characters. Since there are no female characters, it is evident that there are more male, active characters than female, active characters. Almost every character is illustrated once. The characters that do reoccur do not have a prominent role throughout the book. Therefore, every character is a background character and thus, they all have a minor role.

The third book, *Programmeren met Python - Generation Code*, has two major characters that guide

gender	ethnicity	activity		role		interactions		
		active	passive	major	minor	H/H	H/A	H/O
<i>Programmeren voor kinderen - Python</i>								
neutral	black	-	-	-	-	-	-	-
	white	1	6	-	7	1	-	1
	multiple/other	1	-	-	1	1	-	-
female	black	-	3	-	3	2	-	-
	white	24	54	-	78	26	6	3
	multiple/other	8	21	-	29	12	-	-
male	black	12	13	-	25	12	1	-
	white	24	53	-	77	28	5	-
	multiple/other	15	19	-	34	19	1	2

<i>Programmeren met Python - Studio Visual Steps</i>								
neutral	white	-	1	-	1	-	-	-
male	black	1	-	-	1	-	-	1
	white	14	11	-	25	4	2	1

<i>Programmeren met Python - Generation Code</i>								
neutral	multiple/other	-	3	-	3	-	-	-
female	white	1	7	8	-	3	-	-
male	black	2	9	11	-	3	-	-

<i>Stap voor stap leren programmeren met Python</i>								
neutral	positive	-	2	-	2	-	-	-

Table 2: Distribution of gender, ethnicity, activity, role, and interactions (human & human(H/H), human & animal (H/A), human & other (H/O)) per book

the child through the book. When the characters are active, they work on a tablet. This happens once where the characters interact. In this instance, the male character works on the tablet, whilst the female character watches. In general, the male character appears more often and is active more often than the female character.

There is only one character in the last book, *Stap voor stap leren programmeren met Python*. This character does not interact with anyone, is passive and does not have a major role.

5.1.3 Clothing and hairstyles of characters

Table 3 shows the colour of the clothing that is worn by the characters. Table 4 shows which hairstyles occur throughout the books.

In the first book, *Programmeren voor kinderen - Python*, a wide variety of colours appear in clothing. The primary colours blue, green, and red are the most common colours. In addition, characters appear with a variety of hairstyles. The hairstyles Afro, dreadlocks, and braids appear throughout

	black	blue	brown	green	grey	orange	pink	purple	red	white	yellow
<i>Programmeren voor kinderen - Python</i>											
clothing	22	65	2	63	6	16	14	39	46	9	17
shoes	23	43	25	34	-	10	11	32	36	-	11
headwear	10	11	3	3	5	6	1	3	11	5	11
eyewear	12	4	2	2	3	-	1	6	19	1	3
bags	-	2	-	2	-	-	-	2	1	-	-
<i>Programmeren met Python - Studio Visual Steps</i>											
clothing	4	5	1	1	2	-	3	-	3	2	4
shoes	4	1	1	1	-	1	-	-	-	-	1
headwear	4	6	-	9	1	-	14	-	3	6	6
eyewear	3	-	-	-	-	-	-	-	-	-	-
accessories	17	-	-	-	-	-	-	-	-	-	-
<i>Programmeren met Python - Generation Code</i>											
clothing	-	15	-	-	-	7	-	-	-	-	11
headwear	4	-	-	-	-	-	-	-	-	-	-
eyewear	11	-	-	-	-	-	-	-	-	-	-
<i>Stap voor stap leren programmeren met Python</i>											
clothing	-	2	-	-	-	-	-	-	2	-	-

Table 3: Clothing of characters and it's colours per book

	blonde	brunette	black	grey	red	other	total
<i>Programmeren voor kinderen - Python</i>							
Afro	-	-	3	-	-	-	3
dreadlocks	-	-	-	-	-	1	1
braids	1	4	-	-	2	-	7
loose, short	10	30	38	-	3	4	85
loose, medium	6	14	20	1	-	1	42
loose, long	3	7	8	2	1	1	22
<i>Programmeren met Python - Studio Visual Steps</i>							
Afro	-	-	1	-	-	-	1
bald	-	-	-	-	-	-	1
loose, short	-	-	24	-	-	-	24
<i>Programmeren met Python - Generation Code</i>							
loose, short	-	-	11	-	-	-	11
loose, medium	-	10	-	-	-	-	10

Table 4: Hairstyles of characters per book

the book, but much less than hair that is worn loose. The hair colour that appears the least is red and the hair colour that appears most is black.

Regarding the outfits of the characters in *Programmeren met Python - Studio Visual Steps*, the most used colours are black and pink. The high value for pink can be explained by the use of this colour in the headwear. Party hats recurred throughout the book and were often (partly) pink. The majority of characters have short, black hair. There are two exceptions, there is one black male character with an Afro and one bald male character.

The two characters in *Programmeren met Python - Generation code* wear the same outfit throughout the book. The female character wears a blue hoodie, the male character wears a yellow long sleeved shirt. In addition, the male character wears black glasses. The headwear consists of a baret that one of the turtles wears throughout the book. The male character has short black hair, the female character has medium long brown hair.

Finally, the one character in *Stap voor stap leren programmeren met Python* wears an astronaut suit, which is blue and red. The hair of this character is not visible due to the helmet of the suit.

5.1.4 Existing and famous people

Programmeren voor kinderen - Python is the only book that mentions existing and/or famous people. In the beginning of the book six people are introduced who exist in real life. These characters consist of the writer of the book and some other computer scientists. Two of these characters are female, four are male; all of them are white. However, these characters do not return throughout the rest of the book. In addition, another existing and famous person, Albert Einstein, was illustrated twice in the book. This is a white male.

5.2 Colour

The use of colour on pages in every book is reported in Table 5.

The chapters in *Programmeren voor kinderen - Python* all have their own colour. The colours that are used are orange, blue, pink, green, and red. This explains why these colours are the most occurring on the pages in total. The cover of the book has a black background and the pages themselves have a white background. Some text boxes inside the book have a coloured background.

In *Programmeren met Python - Visual Studio Steps*, every chapter starts with a picture of a python, which features the colours black, green and orange. This explains the high values for these colours. The cover of the book is partly blue and every page inside the book has a white background. Therefore, the only colour present on the pages is in objects, attributes, and text, which was not included in the analysis.

Programmeren met Python - Generation Code uses the same three bright background colours throughout the book. These colours are green, purple, and red. White and black are often a background colour in a text box. The cover of the book is bright blue with some small yellow and

	black	blue	green	grey	orange	pink	purple	red	white	yellow
<i>Programmeren voor kinderen - Python</i>	14	117	62	12	59	60	156	35	-	22
<i>Programmeren met Python - SVS</i>	22	1	23	-	25	-	-	-	-	-
<i>Programmeren met Python - GC</i>	23	-	8	-	-	-	2	10	9	-
<i>Stap voor stap leren programmeren</i>	-	85	10	-	1	-	-	16	1	150
total	59	203	103	12	85	60	158	61	10	172

Table 5: Use of colour on pages per book

white details.

Finally, *Stap voor stap leren programmeren met Python*, only has light background colours inside the book. The colours yellow, blue, red, and green are used. The cover of the book is dark blue with white and orange details.

5.3 (Gendered) attributes and objects

Table 6 and 7 show the use of (gendered) objects and attributes that occur throughout the books and their colour.

There are more male gendered attributes and objects throughout *Programmeren voor kinderen - Python*, compared to female gendered objects and attributes. Most of these attributes and objects concern sports, such as football, vehicles, and tools. Female gendered attributes often relate to domestic life, for example cooking supplies. The gendered attributes do not have stereotypical colours, except for one very clear female gendered object: a sowing machine. This sowing machine is pastel and bright pink and the fabric that is sown is pastel orange, with pink and purple buttons. The sowing machine is operated by a female character.

In *Programmeren met Python - Studio Visual Steps*, most objects and attributes are neutral. Examples of male gendered objects are a rugby ball, spaceship, baseball bat and ball, and cars. The most occurring colour for male gendered objects are red and yellow, whereas the most occurring colour for neutral objects are blue and yellow. There is one female gendered attribute in the book, which is an earring. However, this earring is worn by a man.

The objects in *Programmeren met Python - Generation Code* are all computer science related, for example computers, tablets, and computer mouses. None of the objects are gendered. Almost every object features the same colour: black, green, red, blue, and yellow. There are no gendered attributes in the book.

In the last book, *Stap voor stap leren programmeren met Python*, there are no gendered attributes displayed. When looking at the objects on the cover pages, there are two objects that are displayed twice: once on the front cover and once on the back cover. The first object is a red car, the second

	black	blue	brown	green	grey	orange	pink	purple	red	white	yellow
<i>Programmeren voor kinderen - Python</i>											
gendered: f	1	8	2	3	7	2	4	6	5	1	10
gendered: m	9	5	6	3	19	8	-	-	8	6	11
neutral	29	49	26	32	34	26	8	19	22	11	27

<i>Programmeren met Python - Studio Visual Steps</i>											
gendered: m	2	2	2	2	1	-	-	1	4	1	4
neutral	3	18	15	16	10	1	11	4	13	5	17

<i>Programmeren met Python - Generation Code</i>											
neutral	-	5	-	6	-	-	-	8	8	-	7

<i>Stap voor stap leren programmeren met Python</i>											
gendered: m	-	2	-	-	2	-	2	-	2	-	-
neutral	-	-	-	-	278	10	-	-	89	731	27

Table 6: Gendered objects and it's colours per book

	black	blue	brown	green	grey	orange	pink	purple	red	white	yellow
<i>Programmeren voor kinderen - Python</i>											
gendered: f	1	1	1	1	2	1	2	1	1	-	-
gendered: m	7	16	3	3	7	4	-	13	18	2	18
neutral	27	76	44	64	16	45	20	38	50	-	61

<i>Programmeren met Python - Studio Visual Steps</i>											
gendered: f	-	-	-	-	-	-	-	-	-	-	1
gendered: m	-	-	2	-	-	-	-	-	1	-	-
neutral	2	3	3	-	4	-	-	-	1	3	6

Table 7: Gendered attributes and it's colours per book

is a pink, blue, and grey spaceship. Both objects are labelled as gendered (male), since they are vehicles. Inside the book, the only objects that are present are used as icons. The icons that are used are a white computer mouse for clicking something; a grey keyboard, that means that the user has to type something; a grey keyboard, that means that there is extra help here; a yellow and grey lamp that indicates a tip; a grey textbooks which means that extra information is available; and finally, a pointing hand with a red and white piece of clothing meaning that you have to execute an assignment. None of these icons are gendered, however it is important to note that the hand has a white skin colour.

6 Discussion

6.1 Characters

In general, every book shows visual gender stereotypes. Men are illustrated more often than women, in addition men are active more often than women. This corresponds with the previous research

conducted into this subject [14, 15, 17, 29].

Two of the books, *Programmeren met Python - Studio Visual Steps* and *Stap voor stap leren programmeren met Python*, do not have any female characters. Moreover, *Programmeren met Python - Generation Code* only has one female character. However, the female character in this book does not look like a stereotypical girl and could also be labelled as neutral. This character wears a baggy sweater and has medium long hair. Likely, a lot of girls will not feel like they can identify with this character. Therefore, these books are likely not approachable for women. In this regard, *Programmeren voor kinderen - Python*, is more diverse than the other books, since both male and female characters appear multiple times.

In *Programmeren met Python - Generation Code*, both characters actively use technology. However, when they interact with each other, the male character uses the technology and the girl watches how the technology is used. Additionally, the male character is actively working on the tablet more often than the female character. This might keep up the stereotype that men are the people who program and work on building technology, while women only watch how men do this or use it after the product is finished. This instance corresponds with the research done in Greece [15], where men are the producers of technology and women are the users of technology. In the other books this was not necessarily the case. However, generally there are more male active characters than female active characters throughout the books.

Characters in the books mainly have positive or neutral emotions, where almost every positive emotion is joy. The majority of the human characters in the books is white. Moreover, Asian characters appear in none of the books. Again, *Programmeren voor kinderen - Python* is more diverse than the other books, since there are multiple characters with an ethnicity that is not white. In addition, *Programmeren met Python - Generation Code* is more diverse, since one of the major characters has a black ethnicity. However, *Programmeren met Python - Studio Visual Steps* and *Stap voor stap leren programmeren met Python* feature no to almost no characters with a black, Asian, or multiple/other ethnicity. Therefore, these two books are not inclusive and diverse and are not approachable to people of colour.

Only one of the books, *Programmeren voor kinderen - Python*, mentions existing/famous people. These characters that exist in real life and are primarily mentioned in the beginning of the book might make children feel like they can succeed in the field of Computer Science, since these people are successful as well. This has a positive impact on the self-efficacy of the child. However, these characters are not prominent throughout the rest of the book and will therefore likely not make a lasting impact.

6.2 Colour

In terms of use of colour inside the books, it is not safe to say that the colour of the book has a relation to the gender the book has been written for, since a variety of colours is used throughout the books. However, the cover of *Programmeren met Python - Generation Code* is bright blue. Even though blue is chosen most often as a favourite colour for both boys and girls, in marketing, blue is

often marketed more towards boys. The fact that this book is mainly blue on the outside might make people tend to think that the book is more for boys.

6.3 (Gendered) attributes and objects

In every programming book, the majority of attributes and objects is labeled as neutral. Nevertheless, there are more male gendered objects and attributes than female gendered objects and attributes. Most of them have to do with sports, such as rugby and football, and vehicles. In total there are almost twice as few female gendered objects compared to male gendered objects: 49 to 102, respectively. For gendered attributes this difference is much bigger: 12 to 94, respectively.

In general, for male gendered objects and attributes, colours that are marketed more towards boys such as blue, red, black, brown and grey appear more than others. However, they also appear more than others in female gendered objects and attributes. Moreover, the colours that are marketed more towards girls such as pink, purple and pastel shades also appear in neutral attributes and objects.

In *Programmeren voor kinderen - Python*, pink and purple do appear in neutral and female gendered objects, but not in male gendered objects. Purple does appear in male gendered objects, pink does not. This corresponds with previous research that showed pink is a gendered colour [28]. This use of colour stands out in the results, however there are many illustrations in this book. Therefore, it will likely not stand out to the reader. *Programmeren voor kinderen - Studio Visual Steps* has a similar trend. There are no male gendered objects in this book that are coloured pink, however there are neutral objects that have the colour pink. This book has less objects, nevertheless it, again, will likely not stand out to the reader.

Programmeren met Python - Generation Code does not feature any gendered objects, but only technology related objects. The lack of objects and attributes related to other subjects might keep the stereotype in place that one has to be very interested in technology to be a Computer Scientist. In addition, it might create or maintain the stereotype that Computer Science only has to do with the technology that is found in devices and working with devices. The other three books also feature Computer Science related objects, nonetheless these books do display objects that are not related to Computer Science as well.

On the cover of *Stap voor stap leren programmeren met Python*, there are two objects, both are gendered towards men. However, inside the book there are no illustrations. There are icons that have the purpose of clarifying what should be done in the exercises. The lack of illustrations throughout the whole book might discourage children in general to buy this book, especially when they are compared to the other books.

7 Conclusion

There is a lack of women in the field of Computer Science and this shortage has multiple causes. Girls do not have much interest in the field, they feel like they will not fit in, there is a lack of female role models, and low self-efficacy [4, 5, 6, 7]. The overarching and most important factor are the stereotypes there are about computer scientists and the field [5, 8]. By introducing non-stereotypical role models and staying away from stereotypes, the self-efficacy of girls improves [9, 10, 11]. In addition, the stereotypes appear less or disappear completely in people's lives. This will cause an increase of women in the field.

Stereotypes are introduced into people's lives from a young age, among others, via textbooks [14, 16]. This thesis aimed to give insight into the visual gender stereotypes in Python programming books for children between the ages of nine and fourteen in the Netherlands. This was done by analysing four programming books: *Programmeren voor kinderen - Python*, by Carol Vorderman; *Programmeren met Python - ontdek de vele mogelijkheden in de wereld van het programmeren*, by Jason R. Briggs (Studio Visual Steps); *Generation Code - Programmeren met Python*, by Max Wainwright; and *Stap voor stap leren programmeren met Python*, by Studio Visual Steps.

The analysis consisted of three parts. In the first part different characteristics for every character were noted. The following details were obtained: species, ethnicity, sex, clothing, gendered attributes, role, activities, emotion, and if the character is existing in real life and famous. In the second part, the most prominent colours on every page were noted. Finally, in the last part every object was analysed. After the data collection, every object was given the label gendered or not gendered, and if it was gendered, it was labelled male or female. This categorisation is based on the marketing of toys.

After analysing the four books, the research question can be answered and it can be concluded that there are visual gender stereotypes in every book. In general, men are displayed more often than women and they are active more often than women. This conclusion matches with research that was conducted previously by [14, 15, 17, 29]. There are no characters with an Asian ethnicity in any of the books and the black ethnicity and multiple/other ethnicities are underrepresented as well. Gendered objects and attributes do not necessarily have stereotypical colours. However, there are gendered objects and attributes and the majority have a masculine connotation. Famous and/or existing people are only mentioned in one of the books and the majority of these characters is white and male.

In conclusion, there are more men than women in the field of Computer Science. This difference is, among other reasons, caused by stereotypes which can be found in programming books for children. Reducing the occurrence of stereotypes or completely staying away from them will not fix the problem, however it might be a good start in making girls more excited about the field.

8 Limitations and Further research

This thesis analysed the visual gender stereotypes in Python programming books for children between the ages of nine and fourteen. However, there are some limitations and there is more research that could be conducted into this subject.

The main limitation of this research is the subjectivity of the labelling. For example, *Programmeren met Python - Generation Code*, has one character that is labelled as female. However, this character could also have been labelled as neutral. If another person would analyse the same books, other labels for characters and gendered attributes and objects might have been chosen.

As children learn to read and write between the ages of six and nine, the books do contain texts. However, this was not considered in this thesis. Nevertheless, text can have an influence on books being written more for boys or girls. For example, text can be written with a fixed mindset or a growth mindset. Text that is written with a fixed mindset is based on the idea that someone is either good at something or not at all. A growth mindset is written with the idea that skills can be improved with practice. Research [39] has shown that people with different genders and from different fields prefer texts that are written with a certain mindset. In addition, some characters in the books had text clouds. It might be interesting to analyse if this text has a negative, neutral or positive connotation, and if there is a correlation between this and the gender and/or ethnicity of a character.

In addition, the societal role of a character in the book was not taken into account. This factor can influence the self-efficacy of a child that reads the book, for example when certain genders are mainly displayed in a low-skilled job or a job stereotypical to that gender.

Another factor that might play a role in increasing or decreasing the self-efficacy is a possible person that helps the child, since this person is also a role model. Examples could be a teacher, mentor, or parent that works in computer science, but conforms to the stereotypical computer scientist, it might negatively influence the self-efficacy of the student.

Textbooks for children should be diverse and inclusive towards every child and they should represent the norms and values in the current society. Similar research [31] looked into additional inter-sectional identities in addition to ethnicity and gender. For the programming books that were analysed in this thesis it might also be insightful to look at more inter-sectional identities. An example could be if there are any characters with a disability illustrated throughout the books. In the four books that were analysed, these did not occur.

Furthermore, the analysis almost exclusively focused on women as non-stereotypical role models. However, it can be insightful to look at how many stereotypical men and stereotypical women are displayed throughout the books. Girls still might not identify with a women that is in the field, but conforms to the stereotype. In addition, research has shown that a part of men also like to work in a non-stereotypical environment [25]. By also displaying less stereotypical men throughout the book, more people that do not conform to the stereotype enter the field and the overall existing stereotype might weaken.

Research into the author, publisher and illustrator of the books was outside the scope of this thesis. However, it might be interesting to research if there is a correlation between, for example, the gender of the author/illustrator and the display of stereotypes and gendered attributes and objects. Research into the influence of publishers in the Netherlands has already been done [40]. This research showed that the four biggest publishers in the Netherlands all have some

type of censorship on what can and cannot be illustrated in children's textbooks. Nevertheless, the books that have been researched are not published by these four publishers and they are not specifically written to be used on schools. Therefore, more research on this specific subject is of value.

Finally, there is a lack of research into non-binary children with respect to self-efficacy and stereotypes. Thus, doing more research into this subject can improve the analysis that was made for this thesis.

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