

# A Preliminary Study of Screen-media, Empathizing, and Systemizing in Children

Ni Putu Adelia Kesumaningsari<sup>1</sup>, Meidy Christianty Soesanto<sup>1</sup>, Nova Retalista<sup>1</sup>, Xuan Hongzhou<sup>2</sup>,  
and Wang Yiming<sup>3</sup>

<sup>1</sup>*Faculty of Psychology, Universitas Surabaya, Indonesia*

<sup>2</sup>*Department of Psychology and Behavioral Sciences, Zhejiang University, China*

<sup>3</sup>*Henan Institute of Technology and Science, China*

**Keywords:** Screen-based media use, Empathizing-Systemizing, Autistic Traits.

**Abstract:** This study aims to examine the relationship between screen time and empathizing-systemizing cognitive styles. To date, the present study involved 197 parents of elementary school children in Indonesia, 7-11 years old. Parents completed several questionnaires addressing children's screen-time, screen activities, and Empathizing-Systemizing Quotients (EQ-SQ Child). The results showed that children spent more than 4 hours on average per day with media use, infringes the rules by the American Pediatric Association about healthy duration screen activities for children. The research also found gender preferences toward screen-activities. Boys were reported engaged more with gaming and watching activities than girls. Regarding Empathizing-Systemizing cognitive styles, the result indicates a non-significant relationship between total screen time and Empathizing-Systemizing (E-S). However, a specific relation was found between the type of screen activities and the E-S. Watching activities (TV, videos, and movies), playing video games, and doing homework showed a negative relation with Empathizing. On the other side, watching activities is also related negatively with Systemizing. Moreover, Gaming was found to be correlated with the D-Score. The result highlights the clinical importance of examining the role of media on children development as the finding has suggested the role of media to the E-S cognitive styles, therefore indirectly explained the effects of screen-based media on the development of autism among children.

## 1 INTRODUCTION

The prevalence of autism that escalated over time prompts the investigation of possible environmental factors in autism. Current research tries to figure out other confounding environmental factors in autism (Mazurek, et al., 2012). Environmental risk factors may contribute to the development of autism, perhaps via a complex interaction between genes and environment (Newschaffer, et al., 2007). One environmental factor that has been questioned to the development of autism is the usage of screen-based media.

The question whether screen usage contributes to the development of autism keeps arising, since a research by Waldman, Nicholson and Adilov (2006) appears which reported that the introduction of cable TV in the 80's was followed by a 17% increase in the number of cases of autism, indicating that the question about this issue is not something new.

Media has been linked to the autism since many researches showed that autistic children were highly fascinated with the screen technology. People with autism are more likely to spend the majority of their free time with particular electronic media (Orsmond and Kuo, 2011). In another research, autistic individuals are reported having vigorous choices for screen-based media (Mazurek and Engelhardt, 2013), prefer more on non-social media use, and show lower rates of social media use compared to other disability groups such as speech/language impairment, learning disabilities, and intellectual disabilities. The non-social media refers to media that not stimulate social interaction, for example, video games (Mazurek, et al., 2012). Research in autistic spectrum disorder (ASD) children also indicated that ASD children participate in screen-based activities, i.e. watching television and playing video games more often than any leisure activities, both on weekend and weekdays (Shane and Albert, 2008). The findings seem to suggest that there is a

unique attraction of screen-based media in the autistic individual.

In typical children, the intensive use of screen-technologies seems to exhibit the autistic-like characteristic. Engagement in restrictive interest, lack of social interaction, and repetitive behaviour is a diagnostic feature of ASD (APA, 1994). The intense media influence relates to impaired language acquisition and social behaviour (Tanimura, Okuma and Kyoshima, 2007). On a separate research finding, the screen-media decreasing the children ability to infer the feeling of others. Sixth-grade children in elementary school who receive screen diet within the five days has shown better ability to recognise emotion compared to children who routinely engage with screen technologies (cited in Dunckley, 2015). Research also shows that specific screen-activities, i.e. gaming increases the level of anxiety and social phobia which prompt the deficit of making the social connection among people (Gentile, et al., 2011).

Some investigations in children reflect how the screen-activities affecting the systemizing ability in children, leading to the development of restrictive interest in children. Repeated exposure to cinematic codes presented on film, such as zoom technique, lead to higher scores on search tasks which require children to find detail in the interlaced display (Salomon, 1979; Schmidt and Vandewater, 2008). Other experiments revealed that media use (gaming and television) increases the visual-spatial attention and elevates the ability to track more items in a group of dynamic distractor items, locate a brief target more quickly, and process on-going information more efficiently (Green and Bavelier, 2003; Schmidt and Vandewater, 2008).

Therefore, it can be argued that the use of screen-based media among children contributes to the development of autistic-like characteristic, or, might escalate the autistic traits. Despite numbers of assumption growing about the exciting link between autism and media, research has tried to reveal the indications that exposure to screen-time is possibly related to autism. A retrospective study in infants investigated the role of television in autism. It demonstrates that children with autism started watching television six months earlier, at six months of age, compared to the children without autism. Afterwards, this study's results indicate that earlier onset and higher television viewing frequency might be a precursor of autism (Chonchaiya, Nuntanarumit and Pruksananonda, 2011).

A way to understand the autistic-like characteristic would better explained by the social

brain of autism. The new theory of social cognition in autism suggested that that autistic individual possesses masculinised cognitive traits that are elucidating both of those social and non-social features, namely Empathizing-Systemizing. Further, this theory also categorized the typical cognitive abilities of human into five types of brain, i.e. types as type S ( $S > E$ , more common in males), type E ( $E > S$ , more common in females), type B ( $E = S$ ), Extreme S ( $S \gg E$ , common in autism), and Extreme E ( $E \gg S$ ), that measured by the D-Score, the average of the discrepancies between systemizing and empathizing (Baron-Cohen, Knickmeyer and Belmonte, 2005).

Therefore, the E-S theory by Baron-Cohen (2009), has suggested ASD cognitive traits specifically imposed as Extreme Male Brain conditions, characterised by weak empathizing skills and high systemizing skills. In daily life, ASD individual can be observed to have good analytical skills indicated two majors' islets abilities, but low social skills. From the cognitive perspective, Empathizing (E) refers to the ability to identify and infer others' mental state, while Systemizing (S) reflects the ability to analysed or construct a system by noting regularities and rules (Baron-Cohen, 2009; Baron-Cohen and Belmonte, 2005). The Empathy Quotient (EQ) and the Systemizing Quotient (SQ) were constructed as instruments to test the E-S theory (Baron-Cohen, et al., 2003; Baron-Cohen and Wheelwright, 2004).

Previous research by the first authors about screen-based media use and extreme male brain on 4-6 and 10-11 years children in Indonesia has been trying to examine the effects of media on both of E-S ability and autistic traits (Kesumaningsari, Stauder, and Donkers, 2017). However, the finding seems to be vague and inconsistent. The authors argue that this might be caused by including 4-6 years children as a subject who makes parents hard to estimate the usage of screen-media regarding social media use and also doing homework. Therefore, the current study aims to focus only on finding the relation of screen-based media and E-S cognitive styles in 7-11 years.

The school-aged children were chosen as the subject in this current study is due to several reasons. First, according to the developmental stages, the school ages children already develop a better skill to infer other emotion compared to preschool children. As a consequence, it can be assured that the level of empathizing skills on children is not due to immaturities. Second, the school ages children have more variation in screen

type activity, especially regarding the social media use which might be affected the social skills, highly related with empathizing skills.

To sum up, the current research will try to examine the relation of the use of screen-media on 7-11 years children in Indonesia with Empathizing-Systemizing, which further can be used to explain whether media have a relation on the development of autism which will be reflected on the D-Score. Moreover, today, as the screen technology proliferates and fills with interactive screen media use (any activity with a touchscreen smartphone, console, moving sensor, or keyboard) (Dunckley, 2015), which more or less giving a developmental effect in children, highlighting the importance of the research on this issue.

## 2 METHOD

### 2.1 Participants

This study was a descriptive and correlational study. There were 197 parents with school-aged children between 7-11 years old in Indonesia had participated in this study reporting the condition of their children related to variables measured. Therefore, the sample consisted of 197 school-aged children in Indonesia, 50.3% of boys (N=99) and 49.7% of girls (N = 98). The participant had an average age of 9 from age 7 – 11 years (SD = 1.588).

The inclusion criteria of the participants were having child engages with screen-based media technology and has never been diagnosed with any disorder. The data collection was performed upon an online link contained the measurement scales which computed in Qualtrics online platform. Before completing the questionnaires, participants first completed informed consent pages.

### 2.2 Measures

Screen based media use (i.e. screen-time and type of screen activities) and empathizing and systemizing quotient were explored in this study. The measurement scales utilized in this study were translated into Indonesian Language by the author on April 2017 according to the cross-cultural adaptation guidelines of self-reports (Beaton, et al., 2000). The scales back-translated by an independent translator and reviewed by professionals or expert committee as a final evaluation to confirm there was no substantial loss when comparing the original and the translation scales.

### 2.2.1 Screen - Based Media Use

The media use survey examines the average amount of time children spent in screen-based media use. The survey is completed by the parents. The survey modifies the survey of Mazurek and Wenstrup (2013), focusing only on screen-based media activities during both weekday and weekend such as: (1) Watching television, videos, and movies; (2) Playing video games; (3) Engaging in social media; (4) Internet browsing (5) Working on homework. The researcher also informed the parents that the type of media utilized was not limited to any screen-based technologies, but also included handheld devices, e.g. smartphones and tablets, which might be handled by the children. Parents should give their responses according to a 6-point scale: (0) none at all; (1) less than 0.5 hours; (2) more than 0.5–1 hour; (3) more than 1–2.5 hours; (4) more than 2.5–4 hours; (5) more than 4 hours. Consistent with previous methods used by Orsmond and Kuo (2011) and Mazurek and Wenstrup (2013), an average daily use variable was created for each activity by multiplying the weekday score by 5, multiplying the weekend score by 2, add the both of the value, and then dividing the sum by 7.

### 2.2.2 Empathizing-Systemizing

The E-S Quotient-Child is a questionnaire with 55 items consisting of Empathy Quotient (EQ-C) subscales and Systemizing Quotient (SQ-C) subscales, developed to detect trends in gender-typical behavior of children 4-11 years old. The EQ and SQ Child consist of a list of statements about real-life situations, experiences, and interests in which empathizing or systemizing skills are required. The questionnaire has four alternatives for each question. The parent indicates how strongly they agree with each statement about their child by choosing one of these alternatives: *\_definitely agree*; *\_slightly agree*; *\_slightly disagree*; or *\_definitely disagree* (Auyeung, et al., 2009). In this study, the EQ-C and SQ-C had an acceptable Cronbach's alpha,  $\alpha = .866$  and  $\alpha = .758$  respectively.

## 3 RESULT

Result indicated that children (boys = 99, girls = 98) in current sample spent more than 4 h per day using screen-based media (television, smartphone, I-Pad, computer/laptop, and video games). Explored with t-test, the result also indicated a typically sex

dependent screen activities among children. Boys was reported to spent more time on watching ( $t = 2.030, p < .000, 95\% = .008, .557$ ) and gaming activities ( $t = 2.972, p < .000, 95\% = .184, .908$ ) compared with girls, as a statistically difference on average screen-time was found between boys and girls on the type of screen activities. However, the result did not indicate the typically sex related screen-activities for girls.

With regard to E-S cognitive styles, we found that on average, children had a high level of empathizing ( $M = 27.3, SD = 7.83$ ) based on the EQ score. We also found that children had a low level of systemizing ( $M = 22.3, SD = 6.50$ ). The effects of sex on E-S cognitive styles was found in empathizing, which girls shows a significance difference if compared with boys, where scores of the girls was higher ( $t = -2.884, p < .000, 95\% = -5.321, -1.000$ ). However, no significant sex difference was found with regard to systemizing ( $p > .000$ ). Nevertheless, the sex effects on D-Score remained. Our results show a statistically significant differences in D-Score where boys suggested to be higher than girls ( $t = 3.726, p < .000, 95\% = .014, -.047$ ). In particular, girls have a negative D score, while boys showed a positive D score.

D-Score describes the brain type which derived from the average of discrepancies between systemizing and empathizing. D-Score will express more masculine cognitive traits (male brain) if the D-Score is greater or more positive, indicating the SQ is greater than the EQ. Likewise, the small value or more negative, suggesting that the EQ is greater than SQ which less represent masculine cognitive traits. Therefore, the result suggested that boys having more masculine cognitive traits than girls. The difference between boys and girls related to variables measured are presented in Table 1.

Table 1: t-test Results Comparing Boys and Girls on Screen-Based Media Use, EQ, SQ, and D-Score

	Males		Females		t-test
	M	SD	M	SD	
Media Use	8.77	3.146	8.28	3.237	1.095
Watching	2.88	.971	2.59	1.052	2.030*
Gaming	2.25	1.350	1.70	1.222	2.972*
Social Media	.62	1.027	.91	1.184	-1.803
Internet Browsing	.92	.998	1.02	1.038	-0.717
Homework	2.11	.890	2.06	.848	0.391
EQ	25.72	7.253	28.88	8.106	-2.884*
SQ	22.39	6.453	22.17	6.578	0.237
D-Score	0.01	0.053	-0.01	0.063	3.726**

Notes: N = 197  
 \*\* =  $p < .05$ , \*\*\* =  $p < .001$

Finally, based on Pearson's correlation test, we did not find any significant correlation between the average time children spent on screen-based media toward the empathizing, systemizing, even more the D-Score ( $p > .05$ ). However, the significant correlation was found between the average time children spent in several screen-time activities and dependent variables measured. The correlation test found that there was a significantly negative and small correlation between the average time spent in watching activities and empathizing in 7-11 years children ( $r = -.235, p < .05$ ). This means that high screen-time in watching activities, was related to

Table 2: Correlations among of Variable Measured

	M (SD)	Age	EQ	SQ	D-Score
Media Use	8.53 (3.19)	.338**	-.077	-.053	.041
Watching or Video Streaming	2.73 (1.02)	-.015	-.235**	-.171*	.117
Playing Video Games	1.98 (1.31)	.091	-.208**	-.073	.179*
Accessing Social Media	.77 (1.11)	.390**	.060	-.024	-.094
Internet Browsing	.97 (1.01)	.316**	.070	.030	-.055
Homework	2.08 (.87)	.255**	.150	.112	-.072
EQ	27.30 (7.83)	.142*	-	-	-
SQ	22.28 (6.50)	.082	-	-	-
D-Score	.004 (.061)	-.091	-	-	-

Notes: N = 197  
 \*\* =  $p < .05$ , \*\*\* =  $p < .001$

low empathizing, likewise low watching screen time was related to high empathizing. Further analysis showed that there were also significantly negative correlations between average time devoted in playing video games and empathizing ( $r = -.208, p < .05$ ). Playing video games also shown s significantly positive correlation with the D-Score ( $r = .179, p < .05$ ). Regarding the systemizing, we found that the time devoted in watching activities was associated negatively with systemizing, with small correlation magnitude ( $r = -.171, p < .05$ ) (see Table 2).

## 4 DISCUSSION

The purpose of this study was to investigate the relationship between screen media, empathizing, and systemizing cognitive styles among 7-11 years children in Indonesia further to explain the possible connection between the use of media among children and the development of autism. On average spend more than 4 hours to engage with this technology, which infringes the regular rule by American Pediatric Association about proper duration time to use screen-based media. American Pediatric Association suggested that the appropriate screen-time consumption is less than 2 hours (American Academy of Pediatrics, 2011).

The present study did not confirm the expected findings of the relationship between the average of time children spent on media with empathizing, systemizing, or even more the D-Score which reflected the autistic traits in children. The finding means that the average children's screen time during a week did not contribute to the E-S cognitive styles. Even though non-significant correlation was found between variables measured, one of the interesting findings in this study is that the E-S cognitive styles correlate with time spent on a specific screen-types activity.

The current research demonstrates a significant correlation between watching activities and gaming with empathy in an inverse relationship, suggesting an apparent effect of screen-based media devices on child's empathizing level. The correlation indicates an inverse direction; as a child spends more time on watching activities or playing video games, his or her empathizing score decreases, and vice versa. This result is not surprising because there are a growing number of studies that showed the negative contribution of watching and playing video games activities to empathizing skills in children.

Wilson (2008) has explained that watching, in this case watching television, will affect a child's

level of empathy because the children often relate themselves to the character that they watch. Therefore, according to this argument, the effect of watching activities on child development seems content dependent. In other words, if children are exposed to repeated negative content, therefore it might pose risk for children in how they learn share emotions with others or being empathetic.

Similar to watching activities, the effects of video games on empathy might occur because of the harmful content of video games that been played by the children. A recent experimental study in children has found that frequently aggressive content gaming decrease the emotional and cognitive empathy (Siyez and Baran, 2017), whereas the children will develop more positive attitude if the children play pro socially games (Gentile, et al., 2009; Harrington and O'Connell, 2017). It would occur because there is a cognitive transferring process while children engaged with specific content in screen-based media. A repeated exposure could produce certain long-term effects such as changes to cognitive construct, cognitive-emotional constructs, and affective traits.

Regarding the S cognitive style, it was expected that the time devoted on-screen media should correlate positively with systemizing. The result suggested that watching activities correlate negatively with systemizing. The result does not in line with the direction of relationship that we expect which should be a positive correlation, as several experimental studies have found that the use of screen-based media on children shown positive effects with the ability of children to analyse system or detecting details (Subrahmanyam, et al., 2000; Li and Atkins, 2004; Schmidt and Vandewater, 2008 ). Albeit the contrary findings, the author argues that the relation between watching activities and systemizing is weak because according to the correlation magnitude. After inspecting the empirical mean of the systemizing score, it was found that the systemizing level among children was generally low if compared with the theoretical mean, suggesting an explanation why the expected result did not occur.

Another promising finding was that the relation between screen media and D-Score (standardized score on the EQ and SQ, demonstrating strong sex differences and led to the 'brain types'). The result demonstrated that the time spent on playing video games correlates positively with the D-Score, suggesting the effects of media i.e. video games on the development of systemizing cognitive styles (S brain type) in children. The correlation indicates a

linear direction; as a child spends more time on playing video games, his or her D-Score is increasing, and vice versa. As the D-Score was calculated using the formula  $D = (S\text{-standardized} - E\text{-standardized})/2$ , therefore the more positive the D Score indicating that the sample has more systemizing quotient instead of empathizing quotient score. In short, positive D-Score indicates more S brain type.

From the evidence currently available, it seems fair to suggest that the time devoted to watching television and playing video games related to the development of autism cognitive styles characteristic. At one side, its high use of watching and playing video games was associated with the low empathizing level. On the other hand, the time spent on playing video games was associated with the high systemizing level. As the finding indicates playing video games is related with the tendency of greater S brain type or male brain, the current research suggested that playing video games has a stronger role in developing masculine cognitive traits in children, whereas the time devoted on watching the television takes parts on lowering empathetic skills.

This result ties well with previous studies about autism and screen-based media. Mazurek and Wenstrup (2003) in their study that examined the nature of television, video game, and social media use in children (ages 8–18) with autism spectrum disorders compared to typically developing siblings has showed that children with ASD spent approximately 62% of their time watching television and playing video games, and had higher levels of problematic video game use if compared with their typically developed siblings. Moreover, in another study, Mazurek and Engelhardt (2013) revealed that this problematic video game was significantly correlated with inattention and oppositional behavior in autistic children.

The close link between watching activities and video games in autism is continuing to the ages, as the study by Mazurek, et al. (2012) in youth with ASD has found that majority of youths with ASD spent most of their free time using non-social media (television, video games). A similar pattern of results was also obtained by Orsmond and Kuo (2011) time diaries research which found that watching television and using a computer as the most frequent activities in ASD adolescents' optional activities. The previous studies seem to support the current findings in this research about the role of screen-media to the development of

autism in children that is the time devoted to watching and playing video games.

To sum up the current research manage to find the relation between screen-based media and E-S cognitive style. The current research provides a good beginning for understanding the relationship between screen-based media experience and how does it tie to the cognitive profile of autism. However, there are several limitations of the current research to be considered in further research. First, to measure from the parents observing from their children seems to be indirect data collecting which affecting the validity. The measure of frequency use was based solely on the parental report in a very general term, which might be subject to errors in estimation and recall. Second, the small correlation between variables makes the findings on this study should be interpreted by caution, since the effects of media on the development of autism might only take a small part, notably, however, the relationship is still statistically meaningful. To sum up, future experimental and longitudinal research in this area is needed to test the nature and direction of the causality between the screen-media use and the development of autism among children.

## 5 CONCLUSIONS

The result suggests the role of the time spent on specific screen activities on the development of E-S Cognitive Styles, i.e. watching/video streaming and playing video games. The time spent in watching/video streaming is related with empathizing and systemizing in a positive direction, whereas inverse relationship has found between playing video games and empathizing. The finding is also providing the role of screen-based media, specifically playing video games in the development of S brain type. The result provides an early understanding how does the screen-based media related to autism in children and highlight the clinical importance of examining video games and watching activities as factors that should be concerned in the development of autistic traits in children.

## ACKNOWLEDGEMENTS

The author gratefully acknowledges J.E.A Stauder, Ph.D, associates Professor from Faculty of Psychology and Neuroscience, Maastricht

University, Netherlands who supervised the work by first author about *Media use and the Analytical Brain*” *Screen-Based Media Use and Behavioural Preference in Indonesian Children* as master theses in Maastricht University. This current manuscript is considered as further research expanding the prior research of first author.

## REFERENCES

- American Academy of Pediatrics, 2001. Children, adolescents, and television. *Pediatrics*, 107(2), pp.423-426. 10.1542/peds.107.2.423.
- American Psychiatric Association (APA), 1994. *Diagnostic and statistical manual of mental disorders*. 4th ed. Washington, DC : American Psychiatric Publishing, Inc.
- Auyeung, B., Wheelwright, S., Allison, C., Atkinson, M., Samarawickrema, N. and Baron-Cohen, S., 2009. The Children’s Empathy Quotient and Systemizing Quotient: Sex Differences in Typical Development and in Autism Spectrum Conditions. *Journal of Autism and Developmental Disorders*, [e-journal] 39(11), pp.1509. 10.1007/s10803-009-0772-x.
- Baron-Cohen, S. and Belmonte, M. K., 2005. Autism: a window onto the development of the social and the analytic brain. *Annu Rev Neurosci*, [e-journal] 28, pp.109-126. 10.1146/annurev.neuro.27.070203.144137.
- Baron-Cohen, S. and Wheelwright, S., 2004. The empathy quotient: an investigation of adults with Asperger syndrome or high functioning autism, and normal sex differences. *J Autism Dev Disord*, 34(2), pp.163-175.
- Baron-Cohen, S., 2009. Autism: the empathizing-systemizing (E-S) theory. *Ann N Y Acad Sci*, [e-journal] 1156, pp.68-80. 10.1111/j.1749-6632.2009.04467.x.
- Baron-Cohen, S., Richler, J., Bisarya, D., Guranathan, N. and Wheelwright, S., 2003. The systemizing quotient: an investigation of adults with Asperger syndrome or high-functioning autism, and normal sex differences. *Philos Trans R Soc Lond B Biol Sci*, 358(1430), pp.361-374.
- Beaton, D. E., Bombardier, C., Guillemin, F. and Ferraz, M. B., 2000. Guidelines for the process of cross-cultural adaptation of self-report measures. *Spine*, [e-journal] 25(24), pp.3186-3191. 10.1097/00007632-200012150-00014.
- Chonchaiya, W., Nuntnarumit, P. and Pruksananonda, C., 2011. Comparison of television viewing between children with autism spectrum disorder and controls. *Acta Paediatr*, [e-journal] 100(7), pp.1033-1037. 10.1111/j.1651-2227.2011.02166.x.
- Dunckley, V. L., 2015. *Reset Your Child's Brain : A four week plan to end meltdowns, raise grades, and boost social skills by reversing the effects of electronic screen*. California: New World Library.
- Gentile, D. A., Anderson, C. A., Yukawa, S., Ihori, N., Saleem, M., Ming, L. K., Sakamoto, A., 2009. The Effects of Prosocial Video Games on *Social Psychology Bulletin*, [e-journal] 35(6) Prosocial Behaviors: International Evidence from Correlational, Longitudinal, and Experimental Studies. *Personality and*, pp.752-763. 10.1177/0146167209333045.
- Gentile, D. A., Choo, H., Liau, A., Sim, T., Li, D., Fung, D. and Khoo, A., 2011. Pathological Video Game Use Among Youths: A Two-Year Longitudinal Study. *Pediatric*, [e-journal] 127, pp.319-329. 10.1542/peds.2010-135.
- Green, C. S. and Bavelier, D., 2003. Action video game modifies visual selective attention. *Nature*, [e-journal] 423(6939), pp.534-537. 10.1038/nature01647.
- Harrington, B. and O’Connell, M., 2016. Video games as virtual teachers: Prosocial video game use by children and adolescents from different socioeconomic groups is associated with increased empathy and prosocial behaviour. *Computers in Human Behavior*, [e-journal] 63, pp.650-658. <http://dx.doi.org/10.1016/j.chb.2016.05.062>.
- Kesumaningsari, N.P.A, Stauder, J.E.A, & Donkers, F.C.L., 2017. *“Media use and the Analytical Brain” Screen-Based Media Use and Behavioural Preference in Indonesian Children*. M.Sc.. Maastricht University (Unpublished).
- Li, X. and Atkins, M. S., 2004. Early Childhood Computer Experience and Cognitive and Motor Development. *Pediatrics*, [e-journal] 113(6), 1715-1722. 10.1542/peds.113.6.1715.
- Mazurek, M. O. and Engelhardt, C. R., 2013. Video game use and problem behaviors in boys with autism spectrum disorders. *Research in Autism Spectrum Disorders*, [e-journal] 7(2), pp.316-324. <http://dx.doi.org/10.1016/j.rasd.2012.09.008>
- Mazurek, M. O. and Engelhardt, C. R., 2013. Video game use and problem behaviors in boys with autism spectrum disorders. *Research in Autism Spectrum Disorders*, [e-journal] 7(2), pp.316-324.<http://dx.doi.org/10.1016/j.rasd.2012.09.008>.
- Mazurek, M. O. and Wenstrup, C., 2013. Television, video game and social media use among children with ASD and typically developing siblings. *J Autism Dev Disord*, [e-journal] 43(6), pp.1258-1271. 10.1007/s10803-012-1659-9.

- Mazurek, M. O., Shattuck, P. T., Wagner, M. and Cooper, B. P., 2012. Prevalence and correlates of screen-based media use among youths with autism spectrum disorders. *J Autism Dev Disord*, [e-journal] 42(8), pp.1757-1767. 10.1007/s10803-011-1413-8.
- Newschaffer, C. J., Croen, L. A., Daniels, J., Giarelli, E., Grether, J. K., Levy, S. E. and Windham, G. C., 2007. The epidemiology of autism spectrum disorders. *Annu Rev Public Health*, [e-journal] 28, pp.235-258. 10.1146/annurev.publhealth.28.021406.144007.
- Orsmond, G. I. and Kuo, H.-Y., 2011. The daily lives of adolescents with an autism spectrum disorder: Discretionary time use and activity partners. *Autism: the international journal of research and practice*, [e-journal] 15(5), pp.579-599. 10.1177/1362361310386503.
- Salomon, G., 1979. *Interaction of Media, Cognition, and Learning*. San Francisco: Jossey-Bas.
- Schmidt, M. E. and Vandewater, E. A., 2008. Media and attention, cognition, and school achievement. *Future Child*, 18(1), pp.63-85.
- Shane, H. and Albert, P., 2008. Electronic screen media for persons with autism spectrum disorders: Results of a survey. *Journal of Autism and Developmental Disorders*. 38(8), pp.1499–1508.
- Siyez, D. M. and Baran, B., 2017. Determining reactive and proactive aggression and empathy levels of middle school students regarding their video game preferences. *Computers in Human Behavior*, [e-journal] 72, pp.286-295. <http://dx.doi.org/10.1016/j.chb.2017.03.006>.
- Subrahmanyam, K., Kraut, R. E., Greenfield, P. M. and Gross, E. F., 2000. The impact of home computer use on children's activities and development. *The Future Children*, [e-journal] 10(2), pp.123-144. 10.2307/1602692.
- Tanimura, M., Okuma, K. and Kyoshima, K., 2007. Television viewing, reduced parental utterance, and delayed speech development in infants and young children. *Arch Pediatr Adolesc Med*, [e-journal] 161(6), pp.618-619. 10.1001/archpedi.161.6.618-b.
- Waldman, M., Nicholson, S. and Adilov, N., 2006. Does television cause autism? *NBER Working Paper 12632*, [online] Available at : <https://www.nber.org/papers/w12632>, [Accessed : 1 July 2018].
- Wilson, B. J., 2008. Media and children's aggression, fear, and altruism. *Future Child*, [e-journal] 18(1), pp.87-118. 10.1353/foc.0.0005.