The Influence of Leisurely Screen Usage on Adolescent Mental Health and Academic Performance

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Children of today's society are gaining more exposure and becoming more reliant on the use of technology. In response, the Australian government along with several other nations, have put forth guidelines for recreational screen time, suggesting a limit of "no more than 2 hours per day" (Department of Health, 2019). However, these guidelines are not being met - a report on the physical activity of Australian youth claim that only 14% of adolescents aged 12-17 engage in less than 2 hours of screen time every day, with 32% for children aged 6-17 (Schranz et al. 2018). The Australian Department of Health (2019), have stated that "following these guidelines is associated with better …academic achievement and cognition, mental health and quality of life…" among other health benefits. With such low rates of compliance begs the question of whether following these guidelines actually make a difference in academic performance and mental health.

Evidence has found a negative relationship between screen time and cognitive development in young children (Domingues-Montanari, 2017; Hu, Johnson, Teo & Wu, 2020). Studies have reported excessive TV viewing in infancy to be related to increases in language delay and decreases in school readiness and general cognitive scores by young childhood (Domingues-Montanari, 2017; Hu et al. 2020). However, these impacts also have been found to be content dependent, meaning educational viewing tends to encourage language development (Domingues-Montanari, 2017). Such findings suggest the importance of limiting screen usage within the crucial years of development in young children, however they also translate over to adolescents.

There is a general consensus that an individual's academic ability is influenced by a range of factors and predictors. Intelligence is said to be a predictor of academic

achievement, with some suggesting that 25% of variance is attributable to an individual's level of intellectual ability (Dry, Due, Powell, Chur-Hansen & Burns, 2018). Personality differences are also said to be a contributing factor to academic achievement. An individual who portrays conscientiousness tends to be associated with behavioural traits such as achievement-oriented, motivated and organised, thus representing a strong connection with academic achievement (Dry et al. 2018). In recent years, attention has turned to the influence mental health and wellbeing has on academic performance. Many studies have found associations between poor mental health and poor academic performance within adolescents (Deighton et al. 2018.; El Ansari & Stock, 2010; Tempelaar et al. 2017; Skvarc et al. 2021). Academic achievement within secondary schooling sets up future prospects for adolescents and can have long term effects into adulthood. Evidence has suggested that academic achievement can have an influence on future academic success, employment as well as depression and behavioural issues (Deighton et al. 2018; Dumuid et al. 2017). Most studies concentrating on this relationship tend to focus upon factors of illbeing, however O'Conner, Cloney, Kvalsvig and Goldfeld (2019) found similar trends with positive mental health factors. They suggest that positive mental health can predict positive academic achievement through better learning engagement and opportunities (O'Conner et al. 2019).

Much like intelligence and personality, behavioural factors such as sedentary behaviour, have also been suggested to influence academic performance. Screen usage is thought to be one of the most popular sedentary activity amongst adolescents, with sedentary behaviour being described as the act of engaging in sitting and lying-down activities (Adelantado-Renau et al. 2019). Many studies have found that excessive time spent in recreational screen usage has a negative association with academic performance (Howie, Joonsten, Harris & Straker, 2020; Ishii et al. 2020; Sanders, Parker, del Pozo-Cruz,

Noetel & Lonsdale, 2019; Sharif & Sargent, 2006; Skvarc et al. 2021; Trinh, Wong & Faulkner, 2015; Watson, Dumuid, Maher & Olds, 2021). Importantly, meeting the guideline of less than 2 hours of screen time was actually found to be related to better academic performance (Ishii et al. 2020; Howie et al. 2020; Watson et al. 2021). Howie and colleagues (2020) found 2-5% point increases in the Average Academic Index when guidelines were met, while Ishii (2020) and colleagues found reduced screen time to have "2-2.7 times greater odds of having high academic performance" (p.761). Such results thus support the need for the current screen time guidelines. Ishii et al. (2020) states a review of 35 studies that indicate negative associations with academic performance once the 2-hour threshold is exceeded. Such associations can be linked to a theory of displacement. This theory supported by many studies, suggest that negative associations on academic performance arise due to screen time displacing time spent engaging in educational rich activities such as schoolwork and reading (Garcia-Continente, Pérez-Giménez, Espelt, Adell, 2013; Sharif & Sargent, 2006; Skvarc et al. 2021; Trinh et al. 2015; Watson et al. 2021). Similar to trends found in young children, adolescents engaging in more educational screen usage has been positively associated with increased academic outcomes (Adelantado-Renau et a. 2019; Sanders et al. 2019). However, as mentioned earlier, meeting the 2hour screen time guidelines does not only benefit academic performance, but also mental health and wellbeing.

Sedentary behaviour is also a factor in which can influence the mental health and wellbeing of adolescents. The overall consensus is that screen time negatively impacts on mental health and is often associated with psychological difficulties and distress (Babic et al. 2017; Stiglic & Viner, 2019; Tang, Werner-Seidler, Torok, Mackinnon & Christensen, 2021; Trinh et al. 2015). The relationship however, between screen time and mental health can be

seen as quite complex, yielding bidirectional associations dependent on what is precisely being measured. An increase in screen time can be seen to negatively associate with wellbeing, while also having positive associations with measures of illbeing and various negative psychological impacts (Babic et al. 2017; Stiglic & Viner, 2019; Tang et al. 2021). Again, a theory of displacement can be attributed to such effects, with Babic and colleagues (2017) suggesting that opportunities to participate in mental health promoting activities are displaced by excessive screen usage. On the other hand, Sanders et al. (2019) mentioned an association between a moderate amount of screen time and a higher level of wellbeing. This association was explained by social media being beneficial to social functioning and thus improving overall wellbeing (Sanders et al. 2019). Likewise, Samad, Nilashi and Ibrahim (2019) also state a similar theory of social media benefiting wellbeing, but also linking these benefits to educational outcomes, claiming it “enhances collaboration between students” (p.2089). As can be seen, the exact association between screen time and mental health is inconsistent and needing further research in order for this relationship to be understood more clearly.

Overall, evidence largely indicates that adolescent academic performance is influenced by a range of varying individual differences. However, academic performance is also largely impacted by mental health and sedentary behaviour such as screen time (El Ansari & Stock, 2010). Mediating effects of screen time have been proposed on the association between mental health and academic performance. Sharif and Sargent (2006) indicated that adolescents with lower self-esteem had increased media exposure which also had links to poor school performance. The current study aimed to investigate such effects on longitudinal data of Australian children using the following aims:

1. To investigate the relationship between screen time and academic performance

2. To investigate the relationship between screen time and illbeing
3. To investigate a mediating relationship of screen time on academic performance and illbeing

Method

Sample

Data was drawn from the Longitudinal Study of Australian Children. Beginning in 2003, this nationwide study follows 2 separate cohorts of differing age groups, beginning at 0-1 years (B-cohort) and 4-5 years (K-cohort), collecting data every 2 years using an array of methods (Sanson et al., 2002). The purpose of the study is to gather national data on the all the important aspects and experiences that are involved in an Australian child's life (Sanson et a., 2002). Participants of the current study were taken from the Wave 6, K-cohort, meaning at the time of data collection, participants were 14 or 15 years of age.

Measures

The Time-Use Diaries (TUD) were used to obtain screen-time data. The TUD for the particular cohort and wave involved in the current study required the participating child to record all activities they engaged in on a given day. The purpose of the TUD is to provide an insight into how children spend their time and their daily routines (Mullen, 2014). In order to extract specific screen based specific activities, the time spent on an activity corresponding with the specific screen activity codes were summed to obtain total time spent in minutes engaged in screen activities. For the current study, the following activities were considered for leisurely screen time; playing games (electronic device), watching tv/movies/videos, spending time on social networking sites, video chatting, texting/emailing, online chatting/instant messaging, internet shopping, downloading/posting media, general internet browsing, general application use and electronic devise use.

Academic performance was represented using the National Assessment Program – Literacy and Numeracy (NAPLAN). This is a nation-wide test administered in grades 3, 5, 7,

and 9 and examines student capabilities in reading, writing, language conventions and in numeracy (Daraganova, Edwards & Sipthorp, 2013). Participants of the current study were completing grade 9 during data collection and so the grade 9 NAPLAN results were used to represent the most current level of academic performance. Results for each academic area were based according to the number and complexity of correct answers and were given scaled scores ranging from 0-1000 (Daraganova et al. 2013; National Assessment Program, n.d.). This means that an individual who correctly answers more complex questions will obtain a higher score than to someone who answers more simple questions regardless of the number of correct answers (National Assessment Program, n.d.). For the current study, scores from each academic area were combined to obtain an overall mean score. Higher scores indicated a higher level of academic performance.

Mental health or levels of illbeing, were measured using the Strengths and Difficulties Scale. The scale involved a behavioural screening questionnaire using 25 items relating to emotional symptoms, conduct problems, hyperactivity/inattention, peer relationship problems and prosocial behaviour (Goodman, Meltzer & Bailey, 2003). The internal reliability yielded a Cronbach's alpha of .82, meaning that this scale can reliably be used to measure illbeing (Goodman et al., 2003). The total difficulties score, involving the first 4 measures was used to represent levels of illbeing. Scores range from 0-40, with higher scores indicating abnormality and representation of possible behavioural difficulties (Goodman et al., 2003).

The Matrix Reasoning Test was used to control for intelligence in the measuring of academic performance. This test was taken from the Weschler Intelligence Scale for Children, Fourth Edition (WISC-IV) (2004) and uses visual output to assess a child's ability in 'higher level reasoning' and working memory (Dugbartey et al., 1999). An imputed score

was used to represent the level of matrix reasoning in which was based on the number of correct items and age norms provided by the WISC-IV. Due to a lack of data within wave 6, data regarding matrix reasoning was obtained from wave 4 under the assumption that intelligence is a relatively stable construct.

The Big Five Personality Inventory was also used to control for individual personality differences in measuring for academic performance. This brief inventory assesses 5 broad personality dimensions; however, the conscientiousness facet was explicitly used for the current study, due to its relationship with academic performance. Participants responded on a 5-point likert scale to the level of which they agree with a short statement relating to a trait adjective, such as “I am someone who does things carefully and completely”. The score for conscientiousness is based on the mean response of 2 statements, with higher scores relating to higher representations of conscientiousness. The alpha reliabilities for the Big Five Personality Inventory are typically moderate to high (α=0.83) meaning that controlling for personality differences for academic performance is appropriate for the current study (John, Naumann & Soto, 2008). Personality measures were only introduced in wave 7 and therefore were applied to corresponding wave 6 data under the knowledge and assumption that personality is a rather stable construct.

Results

Descriptive Statistics

A total of 2,102 participants were included in the current study, with an equal split of 1,051 between males and females. Table 1 below shows the descriptive statistics for the contributing test variables. As can be seen, the total average screen time, represented in minutes exceeds to the 2hour (120min) guideline for screen usage. The measure of illbeing yielded a mean score of 9.34, which in comparison to the maximum score, indicated that majority of the sample did not show high risk of exhibiting illbeing. The mean academic performance score indicated an overall high level of academic performance from the sample when compared to the minimum score.

Tables 1:

Mean and Standard Deviation Scores for Test Variables

	Mean	SD	Min	Max
Academic Performance	601.30	60.52	385.50	795.4
Intelligence	11.14	2.8	1	19
Conscientiousness	3.24	0.82	1	5
Illbeing	9.34	5.71	0	32
Screen time (min)	220.20	172.41	0	885

Group Comparisons

Table 2 below identified group differences between males and females for the test variables. Females were shown to score significantly higher on academic performance with a small to moderate effect. This indicated that females had a better overall level of academic performance than their male counterparts. On the other hand, females were also seen to score significantly higher than males in illbeing with small to moderate effect. This

then indicates that females tended to report and exhibit higher levels of illbeing. The largest gender difference is shown within screen time, in which with moderate effect, males proportionately engaged in more screen time than did females.

Table 2:

Group Differences Across Males and Females

	Males		**Females**		***t(2100)***	**Cohen's *d***
	Mean	**SD**	**Mean**	**SD**		
Academic Performance	594.44	62.96	608.24	57.19	-5.26**	0.23
Intelligence	11.07	2.84	11.22	2.76	-1.26	0.06
Conscientiousness	3.21	0.8	3.27	0.83	-1.59	0.07
Illbeing	8.71	5.45	9.97	5.89	-5.07**	0.22
Screen time	258.42	182.68	181.96	152.26	10.42**	0.45

** $p<0.001$

Table 3 compares differences in the test variables against the 2hour (120min) screen time threshold recommended by the Australian Government. A total of 1,374 participants recorded spending over 2hours in screen time on a given day, while only 728 participants recorded spending less than 2hours. Of those participants meeting screen time guidelines, 165 participants had recorded spending no time in screen usage. As can be seen in Table 3, all test variables yielded significant differences between groups. For those who met the 2hour guideline obtained a score significantly higher in academic performance with small effect. Meeting the guideline also had a small effect on illbeing, with those who exceeded the threshold having scored higher on the measure. This indicates that those who exceeded the 2hour threshold tend to exhibit a higher level of illbeing. Intelligence and conscientiousness also yielded significant difference in favour of the 2hour guideline.

Although the differences between means are small, differences in conscientiousness obtained a small to moderate effect, the highest of all measures.

Table 3:

Group Differences Across Time Spent in Screen Activity

	<=120(min)		**>120(min)**		***t(2100)***	**Cohen's *d***
	Mean	**SD**	**Mean**	**SD**		
Academic Performance	606.93	60.50	598.38	60.34	3.09*	0.14
Intelligence	11.30	2.93	11.05	2.73	1.91*	0.09
Conscientiousness	3.37	0.83	3.18	0.80	5.10**	0.23
Illbeing	8.67	5.42	9.70	5.83	-3.91**	0.18

*p<0.05, **p<0.001

Correlation Analysis

The correlations shown in Table 4 indicated significant relationships between academic performance and all other test variables. A moderate significant relationship is shown between academic performance and intelligence, indicating that the study's measure of intelligence is an appropriate control for the measure of academic performance. Significant weak negative associations can be seen between academic performance and illbeing and screen time. A significant weak positive association is shown by screen time on illbeing, suggesting excessive screen time increases scores in illbeing. Interestingly screen time shows a significant weak negative relationship with conscientiousness.

Further correlational analyses were conducted exploring the relationships between the specific screen activities (TV viewing, videogames, social media, general device use and communication) and the test variables. Of the screen activities, TV viewing was the only activity to yield a significant relationship with academic performance ($r=-0.13$, $p<0.001$). On the other hand, illbeing obtained significant weak positive relationships with all screen

activities (r=0.04 to 0.08), except for videogames. No other test variables indicated relationships of any statistical significance.

Table 4:

Correlation Coefficients Between Test Variables

	1	2	3	4	5
1. Academic Performance	-	0.48**	0.05*	-0.14**	-0.07**
2. Intelligence	-	-	-0.02	-0.04	-0.06**
3. Conscientiousness	-	-	-	-0.31**	-0.16**
4. Illbeing	-	-	-	-	0.12**
5. Screen Time	-	-	-	-	-

* p< 0.05, ** p< 0.01

Regression Analysis

In order to investigate the effect screen time had on academic performance and illbeing, a hierarchical regression was conducted. As seen throughout the literature and exemplified in the previous tables, academic performance is largely influenced by individual differences, particularly intelligence and conscientiousness. Model 1 calculates the proportion of variance in which these control variables account for in academic performance. ANOVA was run to calculate the model statistics and within Table 5, model 1 can be seen to account for 23.5% of variance in academic performance. Intelligence can be seen to significantly attribute to 0.98 relative importance to this variance.

Model 2 takes into account the proportion to which illbeing contributes to academic performance, whilst still retaining the controls. As indicated by the change in R^2, illbeing attributed a very small, yet significant amount. Illbeing is shown to significantly attribute more variance to the model than conscientiousness, with 0.07 relative importance while

conscientiousness returned non-significant. Illbeing can be seen to contribute a negative effect on academic performance, which is explained through the correlations above.

Model 3 investigates the possibility of a mediating effect of screen time on illbeing and academic performance. As seen in the table below, screen time attributed to a very small change in the model, however this level of variance is non-significant. Intelligence and illbeing retained their significant variance throughout the regression models with 0.92 and 0.06 respective relative importance. This indicated sustained effect on academic performance. Both screen time and conscientiousness account for very little non-significant variance in the last model. There are multiple possibilities for obtaining such a result, with one possibility being another factor, not being measured in the current study, may be contributing to the variance in academic performance more so than screen time.

Table 5:

Regression Model Comparisons

	Model 1 **F(2,2099) = 322.9**** **R^2 = 0.235**		**Model 2** **F(3, 2098) = 229.8**** **R^2 = 0.247.** **ΔR^2 = 0.012****		**Model 3** **F(4, 2097) = 173**** **R^2 = 0.248** **ΔR^2 = 0.001**	
	Beta	**RI**	**Beta**	**RI**	**Beta**	**RI**
Intelligence	10.41**	0.98	10.30**	0.93	10.26**	0.92
Conscientiousness	4.33*	0.01	1.63	0.01	1.36	0.01
Illbeing	-	-	-1.23**	0.07	-1.21**	0.06
Screen Time	-	-	-	-	-.01	0.01

Notes: * p<0.05, ** p<0.001. Beta weights are unstandardised. RI = proportion of model explained variance attributable to individual regressor

Discussion

The overarching aim of the current study was to investigate whether excessive leisurely screen usage influenced academic performance and mental health in adolescents. The results obtained from the study identified trends in support of the aims, but were however non-significant or of little effect.

Ishii and colleagues (2020) found within their study significant associations between screen time and academic performance amongst males. Similar gender effects can be seen within the current study in which males were significantly found with moderate effect to have worse academic outcomes as well as having higher overall screen time. Such results could then be suggestive of a potential influence of screen time on academic performance.

Overall, screen time was found to have a significant, yet relatively small negative relationship with academic performance, which is in support of the previous literature (Howie et al. 2020; Ishii et al. 2020; Sanders et al. 2019; Sharif & Sargent, 2006; Skvarc et al. 2021; Trinh et al. 2015; Watson et al. 2021). This means that increases in screen time ultimately led to decreases in overall academic performance. Group differences comparing academic performance against the 2hour threshold also indicated such an effect. Screen time that exceeded the 2hour guideline was also found to significantly associate with worse outcomes in academic performance, in which this trend can also be seen throughout the literature (Ishii et al. 2020; Howie et al. 2020; Watson et al. 2021). The effect of this association was found to be much stronger and thus supports the initial weak correlation. With these results it can be inferred that screen time has some effect on academic performance, however it does not indicate the exact nature of the relationship.

The current study found a significant positive relationship between screen time and illbeing, indicating that increases in screen time also leads to higher reports and risk of illbeing. This relationship was stronger than that of screen time and academic performance, therefore suggesting that overall screen time has a larger impact on adolescent mental health than it does on academic performance. The current study also found that reports of illbeing were significantly higher with small to moderate effect, when screen time exceeded the 2hour guideline. This supports the findings by Tang et al. (2021) and Stiglic and Viner (2019) in which also report positive associations with screen time, indicating that higher prevalence of depressive symptoms and internalising problems are found with screen time excessive of 2 hours. Overall, the relationships found between screen time and illbeing were conflicting, in which females were shown to have higher scores in illbeing, but engage in less screen time. Such findings along with the relatively low overall scores for illbeing, could suggest that screen time doesn't have a major influence over mental health.

There is a lack of literature on the associations of specific screen activities on academic performance and illbeing and so the current study was interested in investigating such possible relationships. Academic performance was seen to have a significant negative relationship to only tv viewing, while illbeing was found to have significant positive relationships with all activities except for videogames. Due to the large number of non-significant and extremely small results, more research is needed in order to identify exact screen relationships with academic performance and mental health.

The main research aim of the current study was to investigate a mediation effect of screen time on illbeing and academic performance. Illbeing was found to significantly attribute a small amount of variance to academic performance, thus meaning that poor mental health is likely to effect academic performance to some small degree. There is a lack

of literature investigating similar mediation theories, however these results support the literature identifying associations between poor mental health and academic performance (Deighton et al. 2018.; El Ansari & Stock, 2010; Tempelaar et al. 2017; Skvarc et al. 2021). Unfortunately, screen time obtained a non-significant result indicating that it did not attribute any meaningful variance to academic performance. Such a result could be due to a variety of reasons. This likely indicates that an influence of other unmeasured factors could be attributing to significant variance in academic performance more so than screen time. This result could also be due to the extremely small level of variance obtained, suggesting that even with a significant result, screen time does not attribute enough variance in academic performance to warrant an explanation of mediation. This simply highlights the need for further research to fully understand the relationship of screen time on academic performance.

Limitations and Strengths

There were a few limitations to the current study in which would need to be considered for further research and use of the LSAC data. Only primary activities were used to calculate total screen time, not taking into account engagement into any secondary activities. Participants were able to report engagement into one activity as well as simultaneously engaging in a second activity. This therefore meant that some time spent in screen activities were lost, however it was not utilised due to the lack attention paid to this secondary screen activity. The last recorded activities for the day were also assumed to have ended when the participants fell asleep, rather than when they went to bed. This is on the basis that some screen activities were started after the participating child recorded going to bed. The total time spent in screen activities was used a representation of typical daily screen usage, however, the TUD was not set to be completed on a specified day. Some

diaries were completed on school days, weekends or even school holidays which greatly impacts on the level to which time is spent in specific activities.

A major strength of the current study was the use of the LSAC data. The LSAC collects in-depth data in a huge variety of topics. Each measure contains quite detailed information which allowed for specific information to be obtained and specific questions to be investigated. In relation to the current study, the LSAC data provided the opportunity to discriminate the screen activities. A limitation to many previous studies was the fact that educational usage was included into the overall screen time and thus skewing results. The TUD gave the current study the ability to select specific screen activities that would be indicative of leisurely use. However, the context and content in which screens were used was still unknown, specifically for activities such as general device use, internet browsing and application use in which could have been used for educational purposes.

Conclusions

Overall, it can be said that screen time has some influencing effect on academic performance and mental health, however a lot of uncertainty still shrouds this topic and is needing further investigation. The results obtained from the current study indicate that moderation is key for screen usage. Even though no large effect occurs, exceeding the 2hour recommended screen time does show to have some effect, often leading to worse academic outcomes and reports of mental health. This highlights the importance of monitoring adolescent screen usage to encourage better life outcomes and opportunities. The increase in technology only pushes the need for further research on this topic as adolescents become more reliant on it for daily functioning.

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