

The Effect of the Use of Early Learning Apps on Social Anxiety in Preschoolers

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Abstract. In recent years, the phenomenon of children using electronic devices has become prevalent. The screen time of preschoolers has exceeded the upper limit of one hour per day suggested by the WHO. Meanwhile, with the improvement of educational concept—edutainment, the formative educational apps meet the needs of “light education”, recognized by the public. Foreign studies indicated that oversupply of screen stimulation will affect brain region function, which is positively relevant to the psychological problem: social anxiety. This research adopts literature analysis. The literatures come from authentic academic websites (Google Scholar, Web of Science). The research gap is identified, and the research results are integrated according to the process of systematically collecting, screening, organizing, and interpreting. The research results indicate that the impact of educational apps on preschool children's social anxiety mainly manifests in three aspects: impact mechanisms, the role of multiple subjects, and the role of mediating variables. Based on the above research results, the study draws the following conclusion: The use of early educational apps can cause cognitive overload in preschool children, crowd out opportunities for real social interaction, and lead to their missing the critical period for social skill development. Combined with the influence of parental upbringing behaviors, defects in app design, and the role of mediating mechanisms, these factors collectively affect the level of social anxiety in preschool children.

Keywords: Edutainment; Social anxiety; Preschooler; Early Learning Apps.

1. Introduction

Driven by digital development, IT and smart terminal devices are popularized, and deeply permeate the daily life of children. The universality of children's screen use behavior and earlier exposure to screens characterize the contemporary education situation in China and the children's developmental field. According to the statistics of the research report, in the development of formative educational apps industry, in 2023, the user scale of these apps has exceeded 400 million, of which children aged 3-12 constitute the majority (60%). This phenomenon demonstrates two-sided effects of these apps, including providing a shortcut for child's early learning and the increase in frequency and time of their screen use.

The present study lies in the field of digital media and children's early social-emotional development. The main problem is how early childhood education apps influence the core social-emotional capacity of preschoolers: social anxiety.

Early studies in Western countries focused on the impact of education apps on preschoolers' cognition and techniques. It is held that language learning apps can improve vocabulary and oral expression, while overuse of these apps may distract their attention easily, and it is difficult to balance education and entertainment. Their studies were also conducted from multidisciplinary aspects, like education, communication, and psychology, about the impact on preschoolers' social emotions. While Chinese research indicated that children's over-exposure to early childhood education apps may cause a reduction in their virtual interaction with others, discourage their social capacity, and increase their level of social anxiety. Meanwhile, lack of sleep hinders the effective way to alleviate social anxiety and destroys the immune system [1]. Fundamentally, the fault in the design of the apps is a lack of interaction, and violence in the apps may put pressure on them [2].

The American Psychiatric Association has defined preschoolers' social anxiety as feelings of anxiety and fear generated in social activities, unfamiliar environments, and contact with strangers, affecting their current socializing and giving rise to chronic mental problems [3].

The magnitude of users of learning apps for early childhood verifies the prevalence of these apps, with the simultaneous problem of social anxiety. The positive relevance between these two phenomena has aroused the attention of the education circle and the children's psychological development circle. This study aims to identify potentially problematic design elements of apps so as to improve them. Under high working pressure and with less effort and time for accompanying their children, parents' over-reliance on these apps is caused by their escapism and risk-taking mentality [4]. It is suggested to be replaced by scientific and appropriate usage of apps on one's initiative. Professional strengths from correspondent circles will be involved in the judgment and regulation of the era's result. Meal replacement can be supported and turned into a benign complementary food for children's development.

This study will adopt the method of literature analysis. Some influential literature, with real statistics in China and certain analyses of the relationship, is selected for the foundation of this research. According to the direction of this research, targeted extensions and complements are produced to interact with the former studies and complete the research chain.

This research will address the following questions and intentions:

1. How does the use of apps impact the level of preschoolers' social anxiety?
2. Why does it affect the level of social anxiety?
3. Propose some advice for parents to use the apps appropriately.
4. Define the early education form: education coordination of reality and virtual reality.

2. Theoretical Basis

2.1. Theory of Cognitive Development Stages

Piaget's Cognitive Development Theory defines children (2-7 years old) as the pre-operational stage [5]. The core cognitive features of this stage set a development starting point for the formation of children's social competence, forming the backbone of the basic theory of social development. From the perspective of cognitive mechanism, children at this stage have self-centered thinking, relying on the first-person perspective. It is difficult for them to get rid of objective experience to empathize with others' intentions, wants, and feelings, and put themselves in others' shoes. At the same time, they rely more on concrete cognition. Children understand the abstract social rules through concrete and perceptible matters or scenes, like interaction or observation through subtle facial expressions. Abstract subscription or visual symbols are beyond their cognitive capacity.

The development of children's social capacity is required to be in line with the cognitive features of the pre-operational stage, namely, starting from simple and concrete interaction, and complex social behavior is conducted through a step-by-step transition. A study of high-fidelity clinical simulation about the relationship between anxiety and cognitive levels involves 41 undergraduate medical students, assessing the three components of cognitive level: intrinsic cognitive load, extraneous cognitive load, and self-perceived learning [6]. After the simulation scenario, state anxiety is related to extraneous cognitive load rather than the other two. This correlation is the same between the child's anxiety level and the influence of using early learning apps on them. Concrete causes for children's anxiety include high-demand tasks, complex operating procedures, excessive advertisement pop-ups, and interactive design disconnected from real social conditions. If the exterior factors overburden the cognition at this stage, social anxiety is the consequent result.

2.2. Displacement Hypothesis

The Displacement Hypothesis means that children's screen use and interactive behaviors on early learning apps crowd out their opportunities to participate in face-to-face time and interaction. The hypothesis involves three aspects: time, interactive mode, and social feedback. The fact of their screen

overuse is far beyond the limited one-hour time recommended by WHO, which, accordingly, replaces the time for peer play and parent-child interaction. Instead of the previous interactive mode, the interaction of these apps is passive. The learning material is given directly, like watching teaching videos, which can be seen as an incomplete part of reception learning. Meanwhile, the interaction space is fixed: clicking on the preset options, replacing the active exploration in a real social situation, and restricting their divergent thinking. Take, as an example, the reaction to rejection from other children, learning to accept this negative feedback, and reconstructing the courage for the next active invitation, all matter in the socializing process. These apps deprive them of social skills practice. The social feedback is simplified by timely rewards like a visual rewarding star or rankings, while multiple feedback in real social interaction is not only that, such as positive expressions and encouragement from peers and teachers, and a sense of self-fulfillment after overcoming difficulties on their own. Children find it hard to adapt to these various assessments from different people, which results in resistance to social interaction.

2.3. Means of Influencing Social Anxiety

2.3.1 The factor of children

In view of the theoretical basis mentioned before (2.2.1), children, at the age of 2-7, are in the pre-operation stage. Their cognitive features: self-centered nature and concrete cognitive preference of children double the influence caused by the factor of app design. Take an example of the “Three Mountain Task” conducted by Piaget [7]. The experimental subject is set at a fixed position and is asked, “What can the doll see?” (The doll is set at the other position.) They chose the picture showing the vision from their own rather than from the doll. In this case, the early learning app is another “Three Mountain Task”. Children are set at a logical position for visual interaction and feedback. It intensifies their self-centered nature. The personal rankings, single thumbs up, and low effort rewards all send them a message: the world revolves around them. Thus, they can only understand social interaction from a self-centered vision, and they are not required to think about the questions, like “what can I do for my peer? How can I help them?” As a consequence, when they step into the real social situation, they would like to be praised or receive 100% respect and recognition. Without prospective feedback, conflicts and rejection appear. Whereas they cannot think in an abstract way to draw the reason correctly, the thinking mode taught by the apps is wrong. They attribute it to their performance or horrible socializing. This consistent feeling of frustration and misunderstanding causes social anxiety, actually.

When children construct the theory of mind, namely the foundation for understanding different thoughts, beliefs, and emotions, they rely on a complicated and multisensory “social signal system” for social interaction. Subtle facial expressions, produced by muscle contraction, are recognized. (slightly twitching the corners of the mouth, raising eyebrows) Body language and posture: Whether the peer is open to acceptance or defensive; Tone: The same sentence, said in a different tone, can express encouragement, mockery, or anger; Haptic feedback: Emotional messages conveyed by physical contact such as hugs, high-fives, and pulls.

In addition to the theoretical interpretation of how it affects a child's social anxiety, a more fundamental cause, the physiological structure, should be taken into account.

The neuroscience research of Western University in Canada finds that human brain has a neural network, called social brain, dedicated to processing social information, functioning by the prefrontal cortex for decision-making, empathy and understanding the other's intention and superior temporal sulcus for perceiving biological movements, the amygdala for processing emotions and the mirror neuron system for understanding the actions and intentions as well [8]. The real face-to-face interaction is a multisensory stimulus, making the whole social brain work. Children are required to integrate the vision, sound, and tactile information and then make a response. This process acts as a comprehensive training for the brain muscle. When the social mode, early learning apps offered, is barren and simplified. The facial expressions of the app character are exaggerated and limited. The body language is rigid, lacking tactile information and real context.

2.3.2 Parental factor

With regard to parental factors, the main causes of differences between countries are similar, and actually, nuanced differences exist. Research shows that parents cannot only take the responsibility of children's early education but also use early learning apps [9]. Objectively, the central incentive is parents' busy work. More than 70% parents work over 8 hours, with 30% them often working overtime [10]. This phenomenon appears more frequently in dual-earner households. Out of being physically and emotionally tired after work, parents prefer to use early learning apps as an electronic servant to replace their efforts on their child's early education. At the same time, about 40% parents believe that they know little about their children's cognitive development stages, making it difficult to choose a proper app for tailored instruction, according to their age and cognitive level. Subjectively, parents' escaping mentality and false cognition both exist: some parents are not willing to face up to the challenges brought by home education. They use these apps as a replacement, which not only calms the children's uneasy emotions but also relieves the pressure of household education requirements. Additionally, they depend on the educational functions blindly, believe that these apps can replace their role in the children's cognitive development, and overlook the crucial role of parent-child interaction. This kind of blind use lacks correct guidance, hinders the quality-oriented development of preschooler, and causes their over-dependence on the apps and psychological issues like social anxiety.

On the other hand, the behavior of parents directly influences a child's social anxiety level. A new study shows that either parent has positive impacts on their child with affection, warmth, and acceptance, but negative impacts also exist from the feeling of shame, guilt-tripping, and over-control on their child. The positive effects can lower their level of social anxiety, while the negative ones worsen it. What's more, the overly controlling mother has a greater impact than the father [11]. Subsequently, the child will form a timid, cowardly, and awed character, paving the way for later social anxiety. A subtle balance between autonomy and guidance should be maintained by parents' behavior. Besides, early parenthood also influences a child's social anxiety. One of the main relationships in parenthood is attachment (secure, ambivalent, and avoidant attachment). The experiment, "Strange Situation," set a situation for different families [12]. In this case, Ainsworth observed their different feedback on different attachments. It is inferred that children with insecure attachment are at risk of social anxiety.

2.3.3 The factor of app designing

According to the essay How educational are 'educational' apps for young children? App store content analysis using the Four Pillars of Learning framework, 124 Apps were analyzed, including the top 100 most download educational apps on Google Play and the Apple store [13]. They experienced each app for 20 minutes and scored them respectively according to the four pillars coding scheme (Active Learning, Engagement in Learning Process, Meaningful Learning, Social Interaction). The majority of these apps score relatively low among the four criteria. The figure for 58% Apps is lower than 4/12, classified as "low quality". Especially, the figure for social interaction is by far the lowest, indicating that more than 87% of the top-downloaded apps cannot provide meaningful opportunities for social engagement through high-quality para-social relationships with app characters. This means that children are using these apps in social isolation, missing opportunities to practice and develop social skills. Besides, free apps have more interfering advertisements, irrelevant rewards, and visual or sound effects, distracting preschoolers' learning attention. Meanwhile, compared with the other three pillars, showing an upward trend, the pillar of social interaction has no distinctive correlation with them, inferring that the social function of these early learning apps is inadequate universally. The low quality of these apps without specific social components and their distracting drawbacks creates a correlation between the design of early learning apps and preschoolers' social anxiety.

2.3.4 A mediating variable: sleeping problems

Children who are exposed to screen media use are more likely to have sleeping problems. A study in the Journal of Environmental Research and Public Health conducted an experiment with meta-analysis about the association between excessive screen time, shorter sleeping duration, and obesity among preschoolers [14]. According to the behavioral health indicator, the share of relevant studies about sleeping problems comes first ($n=23$), directly proportional to screen time. Use of screen media, particularly portable devices, is related to shorter sleep duration among children under 10 years old, when these devices are most used by parents for early learning [15]. The influential mechanism involves four aspects: the blue light released by electronic devices can suppress the production of melatonin. Thus, children's circadian rhythm witnesses a sequent change; Using electronic devices for early learning directly occupies the time for sleep; The informative explosion stimulates children's brain cortex, increasing arousal both physically and psychologically; It also raises the levels of night alertness and decreases the time of rapid eye movement sleep. Small screen use, like smartphone usage, has a greater impact on the duration of sleep than big screen use, like television watching.

Subsequently, later bedtime and inadequate sleeping time are related and predictive of social-emotional problems. These social-emotional problems are attributed to internalizing, including indices of depression, general anxiety, separation distress, and inhibition.

3. Conclusion

This research, using the literature analysis method, found a significant positive correlation between the use of early educational apps and the level of social anxiety in preschoolers. The impact of using early educational apps on preschoolers' social anxiety mainly manifests in three aspects: influential mechanisms, the role of multiple subjects, and a mediating variable.

Based on Piaget's Theory of Cognitive Development, this study discovered that the high-intensity interactive design of these apps significantly increases preschoolers' extraneous cognitive burden, which in turn causes anxiety. Meanwhile, drawing on the Displacement Hypothesis, they noted that apps deprive children of opportunities to practice real social skills in three dimensions—time, interaction mode, and social feedback—causing them to skip the critical period for social skill development.

Unsound parenting methods and behaviors, the lack of high-quality social interaction features in app design, and preschoolers' age-specific egocentric traits collectively exacerbate the increase in children's social anxiety levels. Among the mediating variables, sleep deprivation impairs children's ability to self-alleviate anxiety, worsening the vicious cycle where excessive app use leads to heightened mental arousal, which in turn causes insufficient sleep and further intensifies social anxiety.

In summary, this research concludes that excessive app use results in cognitive overload, deprives them of opportunities for real social interaction and the development of social skills, and thus makes them lose the critical period for social skill acquisition. Combined with external factors such as inappropriate parental upbringing, flawed app design, and insufficient sleep, these issues collectively contribute to the elevation of preschoolers' social anxiety levels.

This research also observed that existing studies in the field of digital media and children's early social-emotional development are relatively fragmented. This study is the first to systematically define the complete logical chain of how early educational apps affect preschoolers' social anxiety, filling gaps in research on the synergistic effects of multiple variables and providing new perspectives and analytical frameworks for studies.

To better realize the early education model of "coordination between real-world and virtual education," researchers put forward the following educational recommendations:

Parents should change their parenting concepts and behaviors: control the time and frequency of their children's app use, and select age-appropriate app content for them. App developers should optimize the design of social interaction features and standardize content; Educational supervision

authorities should establish app quality evaluation standards and strengthen educational guidance for parents.

Authors Contribution

All the authors contributed equally, and their names were listed in alphabetical order.

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