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Child-Centered Design in the Digital World: Investigating the Implications of the Age-Appropriate Design Code for Interactive Digital Media

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ABSTRACT

In this paper, we conduct a content analysis to investigate the implications of the "Age-Appropriate Design Code" for the design of interactive digital media children are likely to use. The "Age-Appropriate Design Code" policy framework, implemented in the United Kingdom in 2021 with a modified version later signed into law in California in 2022, shifts the focus beyond just the protection of children's data to a broader focus on how the interaction with digital technologies might affect or even harm children. Our content analysis of both the UK and California codes identifies a number of design considerations framed around four main categories namely design values, communication of information, interactions with technology, and data management. While recognizing the robustness of the Age-Appropriate Design Codes, we also identify certain uncertainties and challenges in implementing guidelines in the context of interactive digital media. Our findings contribute to the ongoing conversation about designing safe and age-appropriate online spaces for children.

CCS CONCEPTS

• **Social and professional topics**; • **Computing / technology policy**; • **Government technology policy**;

KEYWORDS

age-appropriate design, policy analysis, content analysis, child centered design

1 INTRODUCTION

The Age-Appropriate Design Code is a policy framework that seeks to increase the protections offered to children of all ages who are likely to use online technologies. The Age Appropriate Design Code was implemented by the United Kingdom in 2020, coming

into effect in 2021 [31], with an adapted version being signed into law in California in 2022 and coming into effect in 2024 [48]. Both age-appropriate design codes seek to offer a foundation of standards that are aimed at the designers of interactive digital technologies to ensure digital technologies are designed in a way that takes into account the different age groups and developmental needs of children. The age appropriate codes are praised for beginning to acknowledge the developmental differences across children of different age groups [49], and have also received positive feedback on the expansion of the definition of online services to include those that are not just targeted at children, but those that children are likely to access [3]. However, there have also been criticisms of the age-appropriate design codes for failing to account for the diversity of different children that might be represented by the language included in the code [13]. The California Age Appropriate Design Code has also been noted to include less regulatory power in terms of its implementation than its UK counterpart [4, 11].

From the perspective of the design of interactive digital media for children, or that children are likely to access, the specific design implications of either age-appropriate design code are still uncertain. Both age-appropriate codes include a number of design standards and expectations for the designers of interactive media but do not clearly outline what these implications might mean for the myriad of different forms of interactive digital media. The unclear design standards will make it harder for the designers of interactive media that children are likely to access to ensure their designs are age appropriate and do not harm children in ways outlined in the codes.

We sought to address this problem and begin to explore the design implications of the age-appropriate design codes. Our research question was: What are the implications of the "Age-Appropriate Design Code" for the design of interactive digital media that children are likely to use? We conducted a content analysis of both the California and UK Age-Appropriate Design Codes and identified four main categories of design implications. The categories of design implications we identified included design values, communication of information, technology interactions, and data management, with each category consisting of a number of design implications. Our work offers a foundation for other designers and researchers to build on when considering the design implications of the age-appropriate codes in a given design context. We also contribute towards the growing conversation of research aimed at ensuring that technologies are designed to support and protect children of all ages [35, 38, 47]

2 RELATED WORK

2.1 Children and Technology Use

Recent research on children's online behaviors has highlighted a wide range of potential harms related to their privacy and safety [39, 55]. Parents, when expressing concerns about their children's online activity, cite issues such as addiction, sleep loss, anxiety, learning and attention problems, and exposure to violent images [45, 54]. Similarly, children themselves report encountering manipulative techniques like dark patterns, as well as other risks while using the internet [8, 56]. While some research has focused on measures like "screen time" to gauge children's technology use [43], caution is advised against too much emphasis on this metric, as it may not capture the nuanced ways in which children engage with digital technologies [28, 42].

On the other hand, despite the potential risks associated with children's online activity, there are also many positive aspects of technology use. For example, technology can provide children with access to information, facilitate communication and collaboration, and offer opportunities for creativity and self-expression [23, 29, 33, 34]. Furthermore, research has shown that certain types of technology use, such as playing educational games or engaging in social media with peers, can be beneficial for children's learning and social development [24, 42, 46, 50]. Positive reports of technology being used to support learning are also emerging in formal educational institutions ranging from pre-school to the university level [2, 5, 10, 12, 26]. Thus, it is important to consider a more nuanced approach of children's use of technology that considers the specific context that technology is applied in along with the potential risks and benefits of how the technology is used and implemented.

2.2 Child-Centered Technology Design & Regulation

Design and regulatory structures surrounding the use of technology play a crucial role in shaping children's experiences with using technologies, especially online technologies [29]. Studies on the features and policies of children's applications have revealed a controlling and restrictive set of features [9, 10, 19, 51]. However, research has highlighted the importance of adopting child-centered design approaches and regulatory frameworks that prioritize the well-being and safety of children [6, 7, 32]. This includes methodologies such as adapting persona design tools to account for caregivers and children's relationships [1, 6] and using children's data to inform the design of technologies [15, 32].

Efforts to promote child-centered design and regulation have led to the development of policies aimed at protecting children's privacy and data online. Two major policies in this area are the Children's Online Privacy Protection Rule (COPPA) [14] in the United States and the General Data Protection Regulation (GDPR) [30] in the European Union and the UK. While both policies prioritize the protection of children's data online, they differ in their approach and effectiveness leading to different critiques of the policies. COPPA has been criticized for being ineffective at protecting children as it is easy to circumnavigate the regulations by, among other things, claiming that children under the age of thirteen are

not the target of a digital technology [21], while the GDPR has presented a number of challenges concerning its implementation and data collection strategies [30]. The California Age-Appropriate Design Code is an attempt at addressing some of the criticism aimed at COPPA by expanding the definitions of online services to include those that children are likely to use, while the UK's Age-Appropriate Design Code aims to extend the GDPR to incorporate design implications for various age groups [3, 4]. The California and UK Age-Appropriate Design Codes are among the first policy frameworks that aim to extend regulation beyond a consideration of children's data as they seek to expand the focus on how the design of online products and services influence online experiences for children [17].

3 METHODS

Our intention in this study is to explore the design implications included in the California and UK Age-Appropriate Design Codes. We conducted a content analysis on the UK and California Age Appropriate Design Codes [31, 48]. Our study design was informed from the data making, inferring, and narrating content analysis process outlined by Krippendorf [36]. To analyze the age appropriate codes we followed a two-cycle coding process, drawing on initial and pattern coding methods outlined by Saldana [44]. We also drew on the methods of other content analyses of design based documents, including policy documentation, community standards, and codes of conduct [16, 25, 27].

3.1 Data Analysis

During the first coding cycle we used initial coding to inductively identify the design implications from the age-appropriate codes. Given the focus of our research question we used design implications as our unit analysis. We defined design implications as any statement that might influence the design of interactive digital media that children are likely to use. We also kept a broad and open definition of what constituted a design implication throughout the coding process and made sure to discuss any inconsistencies during each coding cycle. Our initial codes mainly consisted of terms that linked directly with the wording of the design implications as outlined in the age-appropriate codes, for example "provide clear privacy information" and "provide an obvious signal to the child when monitored or tracked". We kept the initial codes close to the original wording to ensure that our interpretations of the design implications were tied to the codes.

After coding the initial set of design implications, we used two cycle pattern coding to identify patterns and cluster similar design implications together into broader categories. In the first cycle we looked for patterns between the coded design implications. We grouped together similar or repeated design implications into clusters that were linked by the requirements being asked of the designers. For example, the coded implication of "provide clear privacy information" was grouped under the cluster "Transparency of Information", while the coded implication "provide an obvious signal to the child when monitored or tracked" was clustered into "Parental controls and Tracking". In the second cycle we identified patterns between the clusters and grouped similar clusters together under an overall category. Our grouping process resulted in four overall

Table 1: Summary of Categories and Clusters

Categories	Definitions	Clusters
Design Values	Implications that represented "the principles, beliefs, and goals that guide the design process" [22]	Age-appropriate Design Best Interest of the Child
Communication of Information	Implications that are concerned with the communication of information to children	Transparency of Information Parental Controls and Tracking
Interactions with Technologies	Implications that are related to the children's interactions with the technologies	Adherence to Policies and Community Standards Online Tools Nudges (UK) or Dark Pattern (CA) Techniques Privacy Settings Profiling Connected toys and devices (UK)
Data Management	Implications consisting of standards and guidelines that are concerned with how children's data is managed and protected	Minimum Data Sharing Data Detrimental Data Use

categories of clusters of design implications, namely design values, communication of information, interactions with technology and data management.

3.2   Coding Process

We grouped clusters into the design values category if they related to the "the principles, beliefs, and goals that guide the design process", which we drew from the value sensitive design framework [22]. There were two clusters of design implications related to design values, namely 'age-appropriate design' and 'best interest of the child'. The communication of information category consisted of clusters concerned with the communication of information to children and included the two previously mentioned clusters of "Transparency of Information" and "Parental controls and Tracking". We grouped clusters into the interactions with technology category if they included elements relating to interactivity and included clusters linked to adhering to community standards and policies, providing children with online tools, the use of nudges or dark patterns, privacy settings and profiling. Finally, we grouped clusters into the data management category if they related to standards and guidelines that are concerned with how children's data is managed, protected, and shared. A summary of the categories, their definitions and the clusters that were grouped together can be found in Table 1.

Once we had formed initial categories of design implications, we used them to analyze the codes a second time to ensure we had achieved some degree of saturation across the clusters and categories. To ensure a degree of inter-rater reliability, we met frequently to discuss the implications and categories and we spent multiple sessions collaboratively working on identifying and defining design implication categories together. We also used Miro [41], a digital whiteboard tool, to support collaboration during the clustering process. Our two-cycle coding process combined with the collaborative discussion gave us some confidence that our coding categories are exhaustive and exclusive, although there were some discussions concerning differences between design and governance implications.

3.3   Design and Governance Implications

During our coding discussions, one inconsistency we frequently encountered was the challenge of clearly distinguishing between governance implications and design implications. To address this issue, we agreed that design implications were directly linked to the design of interactive media, while governance implications pertained to the governance requirements specific to each location where the age-appropriate design codes were published. For example, the data protection impact assessment (DIPA) completion and submission requirements varied across different regions. While we did discuss and explore some of the governance differences during our study, we made a deliberate decision to focus solely on design-based implications in the context of this paper. Our primary goal was to ensure that our findings were directly related to the implications for the design of interactive media that children are likely to use. While we acknowledge that governance implications are important to consider within the specific context of each location, we concluded that they are beyond the scope of this paper's discussion.

4   FINDINGS

Our findings are split into four main sections aligning with the four main categories of design implications we identified. These include implications for design values, methods for the communication of information, strategies around the interactions with technologies, and implications for data management.

4.1   Design Values

Design values expressed in the Age-Appropriate Design Codes encouraged designers to embody them as values throughout the design process and were commonly used to underpin some of the recommendations in the other three clusters of design implications. We grouped our implications into two main clusters of design values, one we titled the "age-appropriate design" and the other "best interest of the child".

4.1.1 Age-Appropriate Design. The first design value, which we labeled "age-appropriate design", we found to be a core objective of the age-appropriate design codes. This is expressed in both the UK's Age-Appropriate Design Code: "*Understanding the age range of children likely to access the service – and the different needs of children at different ages and stages of development – is fundamental to the whole concept of 'age-appropriate design'.*" and the California Age-Appropriate Design Code: "*...children of all ages should nonetheless be afforded privacy and protection, and online products and services should adopt data protection regimes appropriate for children of the ages likely to access those products and services.*". We found multiple examples in both codes that emphasize the importance of considering a range of age groups in the design process.

We noted that both the UK and California Age-Appropriate Design Codes provide the same five different developmental stages for designers to consider during the design process. These age groups are*:"...0 to 5 years of age or "preliterate and early literacy"; 6 to 9 years of age or "core primary school years"; 10 to 12 years of age or "transition years"; 13 to 15 years of age or "early teens"; and 16 to 17 years of age or "approaching adulthood.".* The UK Age-Appropriate Design Code goes into specific detail about the requirements for each age group. It does this by providing specific age-related design implications that link to the other two major design clusters of 1) communication of information and 2) interactions with technology. Meanwhile, the California Age-Appropriate Design Code presents the developmental groups without offering many additional details on the developmental differences in implementation.

Another area where the California Age-Appropriate Design Code offers less details than its UK counterpart involves age verification. While both age-appropriate design codes encourage designers to be mindful of the risks inherent in processing data for age verification, the UK Age-Appropriate Design Code offers some additional strategies for designers to use to verify ages. The strategies range from self-declaration to using hard identifiers such as a passport or identity document, and also include a number of technical solutions such as using artificial intelligence or third-party tools. Both the California and UK codes encourage designers to consider the tradeoffs between the risks of processing data and the alternative of applying all of the age-appropriate standards to all users. An example from the UK Age-Appropriate Design Code states: "*...it doesn't mean that you have to ignore any information you do have about the user's age, or that adult users have to be infantilised. It just means that all users will receive some basic protections in how their personal data is used by default.*".

4.1.2 Best Interest of the Child. The second design value we identified was "best interest of the child", which encourages designers to consider ways to protect and support children in their use of connected digital technologies. Both of the age-appropriate design codes encourage designers to place the "best interest of the child" into all design decisions and make provisions if children are likely to access their technologies. The California Age-Appropriate Design Code states that: "*Businesses that develop and provide online services, products, or features that children are likely to access should consider the best interests of children when designing, developing, and providing that online service, product, or feature".* Interestingly, both codes provide guidance in the event of a design tension between values of commercialization and the best interest of the child, with an example here being drawn from the California Age-Appropriate Design Code stating: "*If a conflict arises between commercial interests and the best interests of children, companies should prioritize the privacy, safety, and well-being of children over commercial interests.*"

While the specific details around the types of commercialization that cause harm are not referenced in either of the age-appropriate design codes, there are a number of design dimensions that do relate to well-being and safety that both design codes frame around the "best interest of the child". For example, the UK Age-Appropriate Design Code provides a number of considerations framed around personal data use, including recognizing and supporting the role of parents, acknowledging children's capacity to have their own views, supporting children's rights around identity and play, supporting children's physiological and emotional development, and protecting children from exploitation and harm. However, the dimensions in the UK Age-Appropriate Design Code are underpinned by the framing that "*... the best interests of the child are whatever is best for that individual child.*", which creates some design challenges when considering the large diversity of children that use connected online technologies. We explore these challenges in more detail in the discussion section.

4.2 Communication of Information

We defined the "communication of information" category as design implications that are concerned with the communication of information to children. The category consisted of two major clusters namely "Parental Controls and Tracking" and "Transparency of Information" and primarily consisted of design implications concerning how companies communicate with children and other users.

4.2.1 Transparency of Information. We found that Transparency of Information included 1) design implications about providing clear and understandable policy documents and 2) information concerning a digital service in ways that children are able to understand. While the following excerpt is drawn from the California Age-Appropriate Design Code, both the UK and California design codes emphasize providing "*...privacy information, terms of service, policies, and community standards concisely, prominently, and using clear language suited to the age of children likely to access that online service, product, or feature.*". However, the UK Age-Appropriate Design Code does provide a couple more specific design implications about how to meet these standards, including providing bite sized and "just in time" information, presenting information in a child-friendly way, and making all versions of resources, including those designed for parents, available to children. We also noted that the UK Age-Appropriate Design Code emphasizes that children should be given choices in the ways that resources are presented to them, which include mechanisms that enable them to choose the degree of complexity of the information. We also found it interesting that the UK Age-Appropriate Design Code states: "*It is not sufficient to rely on children or their parents seeking out this privacy information.*", implying that the companies are responsible for communication, not the other way round.

4.2.2 Parental Controls and Tracking. We also found implications concerning tracking, with the UK and California Age-Appropriate Design Codes stating that children should be informed about any type of tracking or monitoring including monitoring by parents and by geolocation services. While the California Age-Appropriate Design Code focuses more specifically on parental monitoring, the UK Age-Appropriate Design Code emphasizes informing children of both parental monitoring and about parental controls. The California Age-Appropriate Design Code states that designers should *"provide an obvious signal to the child when the child is being monitored or tracked.",* while the UK Age-Appropriate Design Code goes further stating that designers *"...make it clear to the child if parental controls are in place and if they are being tracked or monitored.".* Both design codes provided recommendations that extended to other tracking or monitoring services such as geolocation, with an example from the California Age-Appropriate Design Code stating that business shall not *"Collect any precise geolocation information of a child without providing an obvious sign to the child for the duration of that collection that precise geolocation information is being collected.".* The UK Age-Appropriate Design Code also emphasizes that geolocation tracking should be instance specific and turned off after each use, with children being given the choice to turn it on in future interactions.

4.3 Interactions with Technology

We defined the "Interactions with Technology" category as design implications that are related to the children's interactions with the technologies. The clusters included in the category relate to elements of interactivity where companies design decisions directly impact the way children interact with their platforms or games. The UK Age-Appropriate Design Code also included a series of implications for connected toys and devices, which were not featured in the California Age-Appropriate Design Code.

4.3.1 Adherence to Policies and Community Standards. The "adherence to policies and community standards" cluster could be considered mostly self-explanatory, as we found the design implications mainly linked to companies' enforcement of policies and community standards they had communicated to users. Both the California and UK Age-Appropriate Design Codes include design implications that outline that companies must *"enforce published terms, policies, and community standards established by the business".* The UK Age-Appropriate Design Code goes into more detail than its Californian counterpart, as it specifically outlines how policies concerning personal data, user behavior, and content creation should be followed. The UK design code also states that if companies only rely on user reporting to identify potentially harmful content, then they need to have communicated this to users and conducted appropriate risk assessments to ensure that these processes are sufficient to uphold their standards and policies.

4.3.2 Online Tools. The design implications relating to online tools focus on the provision of tools to support children and parents in controlling their privacy and reporting information to the companies. The California Age-Appropriate Design Code states that business shall "*provide prominent, accessible, and responsive tools to help children, or if applicable their parents or guardians, exercise*

their privacy rights and report concerns.". The UK Age-Appropriate Design Code provides additional implications about online tools, including making them age appropriate, prominently displayed, tailored to the rights they support, and to ensure they support communications between the business and the users. Interestingly, the UK Age-Appropriate Design Code offers a number of technical propositions for tools to support specific children's rights, which include: *"a 'download all my data' tool to support the right of access, and right to data portability; a 'delete all my data' or 'select data for deletion' tool to support the right to erasure, [and] a 'correction' tool to support the right to rectification."*

4.3.3 Nudges (UK) or Dark Pattern (CA) Techniques. Both age-appropriate codes included terms around techniques that might manipulate users' behavior, but there was some interesting divergence between the framing in the California and UK age-appropriate codes. In the UK Age-Appropriate Design Code, the term used was "nudge", which was defined with the following example: *"Nudge techniques are design features which lead or encourage users to follow the designer's preferred paths in the user's decision making."* While in the California Age-Appropriate Design Code the same type of behavior manipulation tactics was framed around "dark patterns" which were defined as both *"algorithms that can cause harm to children"* and as *"...system design features to increase, sustain, or extend use of the online product, service, or feature by children, including the automatic playing of media, rewards for time spent, and notifications."* The UK Age-Appropriate Design Code does encourage designers to avoid features designed to extend usage time, but it does not explicitly mention the term "dark pattern". The following examples shows the framing in the UK Age-Appropriate Design Code: *"Strategies used to extend user engagement, sometimes referred to as 'sticky' features can include mechanisms such as reward loops, continuous scrolling, notifications and auto-play features which encourage users to continue playing a game, watching video content or otherwise staying online."*

We also noted a divergence between the framing of the use of behavioral manipulation techniques, with "dark patterns" being framed solely as a negative component while nudges were framed in both positive and negative ways. The California Age-Appropriate Design Code only frames dark patterns as a negative element as seen in an example excerpt stating that businesses shall not *"...use dark patterns to lead or encourage children to provide personal information beyond what is reasonably expected to provide that online service, product, or feature to forego privacy protections, or to take any action that the business knows, or has reason to know, is materially detrimental to the child's physical health, mental health, or wellbeing."* Meanwhile, the UK Age-Appropriate Design Code frames "nudge" in both negative (e.g., *"Do not use nudge techniques to lead children to make poor privacy decisions"*) and positive (e.g., "*use pro-privacy nudges where appropriate*", "*consider nudging to promote health and wellbeing*") ways. These differences in framing might relate to the higher popularity of the use of nudges within the UK policy framework, which are briefly mentioned in the discussion section.

4.3.4 Privacy Settings. "*Privacy settings are a practical way for you to offer children a choice over how their personal data is used and protected*" as outlined in the UK Age-Appropriate Design Code. We

found that privacy settings in both design codes were required to be set to 'high' by default with the UK Age-Appropriate Design Code explaining that *"default privacy settings govern the use of children's personal data if the child does not make any changes to the settings when they start using your online service."* While we found that both the UK and California design codes encourage high privacy by default, the UK Age-Appropriate Design Code provides a number of additional implications around privacy settings. The additional implications included in the UK Age-Appropriate Design Code encouraged organizations to retain children's settings after updates, provide children with age-appropriate information about the privacy settings at the moment they change them, and allow children to change settings for multiple devices or for a specific period of time.

4.3.5 Profiling. We found that the definitions for profiling were almost identical across both the UK and California Age-Appropriate Design Codes, but the UK Age-Appropriate Design Code provides more examples around the nature of profiling. The definition drawn from the California Age-Appropriate Design Code states that *"profiling means any form of automated processing of personal information that uses personal information to evaluate certain aspects relating to a natural person, including analyzing or predicting aspects concerning a natural person's performance at work, economic situation, health, personal preferences, interests, reliability, behavior, location, or movements."* The California Age-Appropriate Design Code states that businesses shall not profile a child by default unless they can protect the children, or it is either necessary to do or in the best interest of the child. The UK Age-Appropriate Design Code provides more details about the different types of profiling ranging from personalization, content feeds, and the use of cookies to track behavioral data. While we initially had categorized profiling as a data management implication, it was the definitions in the UK Age-Appropriate Code around the use of profiling that made us realize that the act of profiling normally changes elementals of interactivity for the users.

4.3.6 Connected Toys and Devices (UK Only). An interesting divergence between the two age-appropriate design codes was that a section for design implications about connected toys and devices was only found in the UK Age-Appropriate Design Code. The UK Age-Appropriate Design Code defines connected devices as *"...children's toys and other devices which are connected to the internet. They are physical products which are supported by functionality provided through an internet connection."* Connectivity is the most important feature with the UK Age-Appropriate Design Code clearly stating that devices without the ability to connect to the internet are not included in the definition despite whether they store data or not. The UK Age-Appropriate Design Code provides a number of design considerations for connected devices including avoiding collecting unnecessary data, anticipating many age groups as users, and being transparent and clear about data usage.

4.4 Data Management

The final category of design implications that we identified was termed 'data management' and consisted of standards and guidelines that are concerned with how children's data is managed and

protected. There were three main clusters we identified that were featured prominently in both of the age-appropriate codes, namely minimum data necessary, sharing data, and deceptive or detrimental use of data. While we identified three major clusters of design implications in this category, there were also references in both codes to other regulatory frameworks concerning data management practices that the standards build on, most notably the GDPR (UK) and COPPA (US). While we did not explore the implications of the other frameworks, we are aware that these frameworks might have additional design requirements concerning data management.

4.4.1 Minimum Data. We found that both the California and UK Age-Appropriate Design Codes required businesses to collect only the minimum amount of data required to perform their core business operations. While both codes shared the design implications around minimum data necessary, there were some divergences in the framing of the design implications. The UK Age-Appropriate Design Code tended to focus on children's autonomy in terms of the services they choose to use and to "*only collect personal data when the child is actively and knowingly using that element of your service.*". While the California Age-Appropriate Design Code framed the minimum data requirements around age verification, stating that business should not "*use any personal information collected to estimate age or age range for any other purpose or retain that personal information longer than necessary to estimate age.*"

4.4.2 Sharing Data. When it comes to sharing data, there were differences in the ways the codes defined and cautioned against sharing the personal data of users. The California Age-Appropriate Design Code has a narrow definition of sharing, framing it only around the sharing of specific geolocation data. The UK Age-Appropriate Design Code provides a much broader definition of data sharing stating that: "*Data sharing usually means disclosing personal data to third parties outside your organisation. It can also cover the sharing of personal data between different parts of your own organisation, or other organisations within the same group or under the same parent company.*" While the California Age-Appropriate Design Code does not mention data beyond geolocation sharing, it does specify that if the end user is a child, then business shall not be deceptive with its data and must not "*...use personal information for any reason other than a reason for which that personal information was collected.*"

4.4.3 Detrimental Data Use. The final category of design implications goes beyond using data deceptively and concerns detrimental use of data. The California Age-Appropriate Design Code emphasizes that data should not be used in ways that could harm children and states that business shall not "*use the personal information of any child in a way that the business knows, or has reason to know, is materially detrimental to the physical health, mental health, or well-being of a child.*" While the UK Age-Appropriate Design Code provides a similar definition it also goes further in stating that organizations must keep up to date with "*relevant standards and codes of practice within your industry or sector, and any provisions within them that relate to children.*" The industry standards that the UK Age-Appropriate Design Code suggest organizations look at are industry specific. These include industry standards such as: the Committee of Advertising Practice (CAP) for marketing and behavioral advertising, the Audiovisual Media Services Directive 2018

(AVMSD) for video sharing platform services, Ofcom On Demand Programme Service Rules for broadcasters, and the Office for Fair Trading (OFT) for digital games.

5 DISCUSSION

Our content analysis of the age-appropriate design codes implemented by the UK and California governments aimed to answer the research question: what are the implications of the "Age-Appropriate Design Code" for the design of interactive digital media that children are likely to use? We conducted a content analysis of both the California and UK Age-Appropriate Design Codes using a two cycle coding process to identify the potential design implications in both age-appropriate design codes. Our coding process resulted in the creation of four broad categories of design implications consisting of design values, communication of information, interactions with technologies, and data management. In the discussion section we attempt to highlight areas where the implications align with research on designing interactive digital media for children and present potential challenges that might arise from the implications. We have structured our discussion using the same four categories identified through our content analysis.

5.1 Design Values

Encouraging designers to incorporate values such as "age-appropriate design" and "the best interest of the child" into the design process is a positive step towards not only acknowledging the rights of children of all ages groups, but also towards supporting and protecting the rights of children in the use of online technologies they are likely to access. The value sensitive design framework encourages designers to use design values that embody elements they want to incorporate into their designs [22]. An emphasis should be made to encourage designers to adopt the design values included within both the California and UK Age-Appropriate Design Code. The age-appropriate design value aligns with research supporting the developmental needs of different age groups through design [35, 37, 47].

However, there are two notable challenges concerning the implementation of these values. While there are some attempts made in the age-appropriate codes to explain developmental differences, there are few examples of direct design recommendations concerning how to support the development of children at different ages. There are also no references to existing design methods for designing interactive technologies for children, such as those exploring different design methods mentioned earlier in the paper [1, 6, 15]. We encourage future work to explore more ways to bring together child friendly design methods with strong underpinnings in developmental theory that assist designers of interactive digital media.

Another notable challenge concerning design values relates to how to define the best interests of the child in an inclusive rather than exclusive capacity. Previous work has noted issues around the use of the best interest of the child to support children in the majority while ignoring those in the minority [13]. Uncertain definitions become problematic in the context of the age-appropriate codes as there are many instances that state that the 'best interest of the child' can be used to overrule certain design standards in the codes. If design standards are overruled to support the majority of children over a minority, then we would be creating exclusive rather than inclusive online technologies. We caution designers to consider inclusive values in addition to values around the best interest of the child.

5.2 Communication of Information

Design implications related to ensuring that information is understandable and that policies are effectively communicated to children and caregivers are an important step in supporting both groups in their use of online technologies. Providing children with policies they can understand can improve their awareness of privacy policies and reporting tools and enable them to take a more active role in managing their own technology usage. It is encouraging to see that both the California and UK Age-Appropriate Design Codes place the responsibility of communication on designers of digital technologies, which may help address the problems of policy documents and codes of conduct being hidden on websites or written in legal jargon [20, 27]. Additionally, both age-appropriate codes require designers to provide children with clear signals about tracking from companies and caregivers, which could encourage caregivers to take a more collaborative role in mediating their children's technology use.

5.3 Interactions with Technologies

Interactions with technology is a critical area when considering design implications, as it is closely related to how children engage with various components of digital technologies. It is encouraging to see language that holds companies accountable in regard to published community standards and privacy policies. While adhering to community standards and privacy policies is an essential step, it is important to note that previous research has identified instances where companies include terms that enable them to change their policies freely and without notice [27], or write terms in a way that allows them to bypass specific requirements [20]. Therefore, there is a need for more rigorous enforcement mechanisms to ensure companies comply with their own stated policies. The age-appropriate codes also highlight the potential of online tools to empower children, such as giving them control over their own data. However, the current codes are limited in the types of tools discussed, and further work is necessary to develop more diverse and effective tools that can support children in different contexts. Ultimately, there is a need to prioritize children's agency and autonomy in interactions with digital technologies while ensuring their safety and well-being. It is also interesting to note that the California code has removed the references to connected toys and devices, which could imply these devices would have been too hard to implement [6].

The last point to discuss concerns the differences in framing behaviorally manipulative design as either nudges or dark patterns, which may reflect potential cultural differences between policy makers in the UK and California. The UK Age-Appropriate Design Code uses the concept of nudges as outlined by Thaler and Sunstein [52], likely linked to the British government's use of nudges by the Behavioral Insights Team, a policy-making team underpinned by behavioral sciences [53]. In contrast, the California Age-Appropriate

Design Code frames the same manipulative design as dark patterns, which aligns more with research on the use of dark pattern design in human-computer interactions and user experience design [8, 18, 40].

An interesting contrast between nudges and dark patterns concerns how they are framed in terms of their usage in design practices. Nudges acknowledge that they can be used for both positive and negative manipulation, and designers are encouraged to use them to support the development of positive behaviors, such as eating healthy foods, through a paradigm of "parental libertarianism" [52]. In contrast, dark patterns tend to focus on negative behavioral manipulation, such as extended engagement or deceptive monetization strategies, and are often used to identify these practices in design [8, 18, 40]. These differences present a number of challenges around how designers implement systems that encourage user interaction and engagement, as there may need to be a more nuanced understanding of each specific context when considering these design techniques. It also becomes challenging to define how behavioral manipulation in the design of systems contributes towards harmful interactions when there is an uncertain and vague definition of what constitutes harm. While both age-appropriate codes link harm to prolonged engagement, there is limited mention of how harm might be found when considering factors such as monetization, social interactions, and self-confidence. Overall, more nuanced work is needed to explore the relationship between system design and harmful interactions across a range of technologies and platforms.

5.4 Data Management

The age-appropriate codes offer necessary guidelines for protecting the personal data of children [3, 4, 39]. The age-appropriate codes expand the definitions of age groups included in COPPA and include online services where children are likely to be, rather than only those explicitly targeting children. Although the age-appropriate codes improve upon the child-specific data practices outlined in COPPA and the GDPR, significant challenges remain regarding data management and children's use of online technologies. One notable design challenge concerns the role of interaction in data generation and how the data generated through interaction aligns with the designs of systems that enable that interaction. For instance, profiling a user requires data about the user, but the interaction in the profiling activity generates additional system-generated user data that is then used in future profiling activities. It is unclear whether this system-generated data output by a "profiling algorithm" is classified as personal user data or simply additional system-generated data. However, this challenge becomes far more complex in online spaces like digital games or streaming services such as YouTube or TikTok, where system interaction can generate data in various ways. To address this challenge, it is necessary to deepen our understanding of the relationship between system interaction and data generation, moving beyond a simplistic perspective focused solely on data storage and protection.

6 CONCLUSION

In conclusion, we set out to understand the implications of the Age-Appropriate Design Code for the design of interactive digital media that children are likely to use. We conducted a content analysis of the codes from both the UK and California Age-Appropriate Design Codes, identifying four main categories of design implication: design values, communication of information, interactions with technology, and data management. Our findings indicate that while the codes provide a solid foundation for the design of age-appropriate online spaces for children, there are still areas of uncertainty and challenges with implementing them in the context of specific interactive digital media. Overall, our research contributes to the ongoing effort to ensure that digital technologies are designed with the diverse needs and developmental stages of children in mind. It highlights the importance of being mindful of the various design implications included in the age-appropriate codes and provides a starting point for future studies. While the age-appropriate design codes are a welcome and needed policy to support and protect children online, there are still many challenges in ensuring online spaces are inclusive and supportive of all of the children that use them.

7 SELECTION AND PARTICIPATION OF CHILDREN

No children participated in this work.

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