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What do players with dyslexia need? A focus group study on video games

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ABSTRACT

In this paper, we present two focus groups we performed to examine the needs and preferences of players with dyslexia in the context of video games. In addition, since these users often struggle with reading, we decided to test easy-to-understand (E2U) language as a way to enhance their experience, as this accessibility feature is not present in current games. After contacting different associations and gathering participants with different playing habits, we performed two focus groups. In the first part of the sessions, we inquired about participants' needs and preferences regarding purchasing and playing video games. In the second part, we provided four different versions of a game excerpt: two in written form (standard and E2U language) and two in audio form (standard and E2U language), and then asked them which version they preferred. Reflexive Thematic Analysis was used to analyse the results. Findings indicate that participants are interested in having all information available in audio format and that they frequently use accessibility features such as subtitles and control remapping. Among the stimuli provided, they preferred the E2U version of the written text and the standard version of the audio, although they did not perceive significant differences between the two versions of the audio. In the conclusion, we outline the next phase of the study, which will involve the application of E2U language in a video game with the objective of paving the way toward more accessible gameplay experiences for users with dyslexia.

1. Introduction

Video games play a crucial role in the entertainment industry. Their development can be a costly endeavour and to maximise their return on investment, developers should ensure games are accessible to the widest possible audience. Game accessibility has been bourgeoning in recent years, although accessibility for players with dyslexia has not received much academic attention to date. In a context where research must address the accessibility needs of individuals with specific barriers or difficulties, rather than relying on broad categories [1], a study focused on the needs and preferences related to dyslexia appears relevant.

Considering the motto of accessibility: "nothing about us, without us", we performed two focus groups to examine the needs and preferences of players with dyslexia regarding video games, as this is essential to find out what accessibility options would facilitate and enhance their gaming experience. Among other things, we expected users to favour and use options related to how text is presented, such as language complexity, text length, and font type, as well as features that support working memory or executive functions, such as reminders or summaries.

In addition, since users with dyslexia often struggle with games that rely heavily on reading, we tested whether using easy-to-understand (E2U) language could improve their gameplay experience. This accessibility option was tested both in written and audio format. It was expected to be beneficial in written form; however, its impact might be less significant in audio form, as the challenges associated with dyslexia primarily arise during reading.

The paper is structured as follows. First, an overview of cognitive game accessibility, dyslexia, and E2U language are presented. Next, the methodology and the main findings of the analysis are described, followed by a discussion. In the conclusion, we introduce the next stage of the study, which entails testing the application of E2U language in a video game.

2. Cognitive accessibility in video games

Today, game accessibility does not focus on players' abilities, but on removing the barriers within video games, aligning with the social model of disability [2]. Specifically, it aims to prevent a mismatch between players' abilities and the obstacles in a game [3]. By doing so, game accessibility promotes the development of customisable video games that accommodate different users' needs. Due to the particular

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nature of video games, barriers can arise when receiving visual or auditory stimuli, when determining a response, or when providing input [4]. From these three steps stem the four main types of game accessibility: visual, auditory, motor, and cognitive, the latter being the least explored [5]. This is still evident in recent titles such as *God of War: Ragnarök* (SIE Santa Monica, 2022), which includes presets for visual, auditory, and motor accessibility, but not for cognitive accessibility.

Nevertheless, both academic and non-academic sources have created different guidelines to implement cognitive accessibility in video games. In a previous study [6], the authors conducted a systematic review using a search string that, after applying the relevant inclusion criteria, retrieved 18 academic and non-academic guidelines on cognitive accessibility. The consideration of non-academic sources stems from their recognition as key contributors of recommendations [7] and from their ability to reflect user perspectives, as all were created directly by individuals with disabilities or with their involvement.

Among academic sources that include recommendations for cognitive accessibility, a consistent trend is to focus on the creation or integration of serious games, often tailored to specific target groups. Some studies address cognitive accessibility broadly [8], while others focus on serious games designed for specific populations, such as *Parque das Galáxias* for individuals with Down syndrome [9] or *Liberi* for those with autism [10]. Regarding dyslexia, Jaramillo-Alcázar et al. [11] include it within the broader concept of cognitive accessibility; in a subsequent study [12], the same group of researchers offered an insightful perspective on game accessibility for this population.

Among the non-academic sources, cognitive accessibility is an essential part of a comprehensive effort to make commercial video games accessible. The systematic review included several guidelines regarding cognitive accessibility. It is the case of the Game Accessibility Guidelines (GAG) [13], with a three-level set of recommendations; the Accessible Player Experiences (APX) model [14], which differentiates between features that aid players to access the video game and those that help players progress through the challenges; the Xbox Accessibility Guidelines (XAG) [15], created by a development company; the Cognitive Accessibility Guide [16], based on testimonies from players with disabilities; the Game Maker's Toolkit [17], a YouTube series about game design that includes several recommendations for game accessibility, and the nine guidelines outlined by the IGDA-GASIG [18].

The main limitation of these guidelines is that their recommendations have not been validated through the scientific method. Nevertheless, they remain valuable because they employ a participatory design or emerge from collaborative efforts involving academics, professionals, and users, as seen in the GAG and APX. Recommendations for individuals with dyslexia include multimodal information delivery, adjustable speed, replayable content, summaries, control reminders, and the use of simple language with highlighted keywords and easy-to-read fonts. The relevance of these recommendations will be further examined in the Discussion section.

3. Dyslexia and video games

Dyslexia is classified as a specific learning disorder, characterised by difficulties in word recognition, poor decoding, and spelling challenges, according to the Diagnostic and Statistical Manual of Mental Disorders V-TR [19]. The origin of this learning difficulty is unknown, although it is widely recognised as hereditary [20] and it is usually associated with a weakness in phonological processing [21,22]. Some dyslexic people have also demonstrated difficulties in letter recognition [23], aligning with the magnocellular theory [24,25]. According to the International Classification of Diseases [26], dyslexia is only identified as an impairment in reading, not related to an intellectual deficit, a visual or hearing impairment, or any other neurological disorder, which makes it specifically cognitive.

This learning difficulty is known to have a profound psychological impact. When people with dyslexia internalise negative stereotypes (e.g., being unable to properly read), they can feel stigmatised [27], which can significantly affect their psychological well-being and academic performance [28]. This creates a vicious cycle: stigma reinforces feelings of inadequacy, while persistent barriers in the learning environment amplify the stigma.

However, there has also appeared a different trend toward emphasizing the abilities people with dyslexia excel at. Dyslexia has been associated with higher levels of intelligence and creativity [29,30], thus originating a positive stereotype focused on inherent gifts. However, this view may lead people to attribute success solely to innate traits, neglecting the role of effort and the adoption of new approaches and strategies to face barriers [31]. Therefore, both types of stereotypes reinforce the differences of people with dyslexia, whether positively or negatively, which does not promote inclusion or a sense of belonging. An effective approach to avoid stigmatisation is the neurodiversity perspective initiated by Singer [32], which highlights that everyone has different abilities and there is not a desirable set of skills to aspire to.

As hinted before, one of the major effects of dyslexia is academic failure [33], but if identified in early years, it can be treated with a potential for improvement [34]. In this respect, video games can serve as training tools, positively impacting the learning process [35]. From a broad perspective, the relationship between video games and dyslexia appears to have evolved along three distinct paths.

First, researchers have created serious games, which are games that go beyond entertainment, typically designed to teach or enhance users' skills [36]. These video games have aimed at improving reading abilities, with one of the earliest examples being *Fast ForWord*, launched in 1996 [37]. A recent literature review by Ekawati et al. [38] indicates that video games can contribute to reading development by reinforcing linguistic competence, enhancing working memory, and supporting executive functions, all of which play a critical role in the learning process.

Second, interventions have focused on the use of Action Video Games (AVGs) with individuals with dyslexia. From the first efforts of Franceschini et al. [39] to the meta-analysis encompassing all publications on the topic [40], the latter study found that AVGs have consistently demonstrated benefits such as improved visual attention and increased reading speed, among other cognitive gains.

Third, accessibility in commercial games has focused on providing options for individuals with this learning difficulty. A notable trend is the implementation of dyslexia-friendly fonts, such as OpenDyslexic,[1] featured in titles like *Overland* (Finji, 2019), *Loop Hero* (Four Quarters, 2021), and the recent *Hauntii* (Moonloop Games, 2024). However, the positive effects of using a dyslexia-friendly font are controversial. Some authors have tested fonts such as OpenDyslexic and Dyslexie, which feature thicker lines at the bottom of the letters to make them more recognisable, and have reached the conclusion that they do not increase readability [41,42].

In line with the social model of disability, this study aims to contribute to ongoing efforts to develop accessible products for people with dyslexia. Specifically, it focuses on how to make video games that are not necessarily serious or skill-oriented, but inclusive by design.

4. The potential application of easy-to-understand language in video games

Some authors provide recommendations about how language can be made accessible in video games, including adjectives such as “simple” or “clear” [13,14]. However, they fail to suggest a specific framework for the creation of written text, one that gives particular guidance regarding the number of lines per paragraph, the type of terminology, or even the font size. This framework could be provided with an accessibility option such as *easy-to-understand* (E2U) *language*.

[1] See https://opendyslexic.org/.

As defined by the International Organization for Standardization [43], this term encompasses all language varieties designed to enhance comprehensibility, originating from different theoretical and practical approaches. On the one hand, *plain language* emerged as a response to the complexity of legal language, with the public demanding clearer communication in legal and official documents [44]. The aim was to simplify texts that impacted the general population but were difficult to understand. On the other hand, *easy-to-read language* was specifically developed for individuals with disabilities, particularly those with cognitive impairments or learning difficulties [45]. Therefore, *easy-to-understand language* serves as an umbrella term that encompasses both approaches, referring to any form of language simplification, whether for people with disabilities or for anyone else who may benefit from greater clarity, such as functional illiterates and language learners [46].

Any language can be made easy-to-understand by following specific guidelines. For written texts, recommendations encompass using 1 or 2 lines per sentence, explaining difficult words, adding bold to highlight important terms, having a 14-size font, or avoiding abbreviations, italics, complex punctuation, and colours, among other things (Inclusion Europe [47]; ISO [43]). For oral texts, additional suggestions include a clear articulation, an appropriate speaking pace, regular pauses, a natural voice, and the customisation of timbre, speed, and other delivery features (Inclusion Europe [47]; ISO [43]). The resulting language is conceptualised as an *easy language* [48], which differs according to the culture or the region, meaning there is an Easy English and an Easy Spanish, among others.

E2U language has not yet been tested in video games. It could be useful for players in order to determine a response to the stimuli of the game [4], as players must understand what is asked of them. After all, video games are unique audiovisual products due to their interactivity [49]. Unlike traditional media, video games require players not just to receive information, but to interpret it and act on it, substantially increasing cognitive effort [50]. Therefore, using E2U language could help reduce cognitive load, improving comprehension and the overall performance of players.

5. Methodology

A useful methodology to gather feedback from players with dyslexia, in line with the primary goal of the study, was the focus group approach [51]. This method allows the inclusion of participants with diverse perceptions and experiences, such as casual versus usual players, while promoting interaction among participants [52]. When conducting the sessions, we followed the common recommendation of working with small groups, as they are easier to manage and foster more discussion [53].

For the analysis of the data, a Reflexive Thematic Analysis [54] was selected because it offers a flexible approach to explore perceptions of accessibility in video games, capturing the complexity and diversity of participants' experiences without imposing a rigid theoretical framework. This method is also well-suited for small samples, as it prioritises depth and richness of meaning over statistical generalization. The details of the analysis are explained in section 5.4.

5.1. Participants

The recruitment process began by contacting over 15 associations related to dyslexia. Some offered support to promote the study via their social media and by sharing the information with their members. In the end, we collaborated with three groups: Associació Catalana de Dislèxia: acd, Disnavarra, and the Service for Inclusion at the Universitat Autònoma de Barcelona. Individuals interested in participating were invited to complete a short questionnaire, which served both to confirm their willingness to take part and to collect basic information such as playing habits, gender, and age.

A purposive sampling accommodating the goals of the research [53] resulted in 14 people showing interest in the study. All of them answered the initial questionnaire. A control question regarding a formal dyslexia diagnosis was included in order to ensure better homogeneity of our sample. However, we did not request official documentation of the diagnosis, as we considered it inappropriate for participants to provide medical records. Such a requirement could have also discouraged participation, particularly given the sensitivity surrounding neurodiversity and related health conditions.

Since playing habits influence the obstacles encountered in a game, that is, someone who plays frequently may have developed adaptation strategies that a non-player might lack [55], we aimed to capture perspectives from both players and non-players. To ensure "playing habits" functioned as a blocking variable, participants were classified based on the latest annual report from the Asociación Española de Videojuegos [56] and the Game Preferences Questionnaire [57]. Three categories were defined, excluding the questionnaire's fourth category related to players of sports and first-person shooters, which was deemed unnecessary in this context. Accordingly, participants were classified as non-players (never play), casual players (play monthly), or regular players (play weekly).

A balance between players and non-players was sought, hence the initial composition of the two focus groups was as follows: one group with six participants (2 non-players, 1 casual player, and 3 regular players) and another with seven (3 non-players, 1 casual player, and 3 regular players). As can be noticed, more than 5 people were included in each session to account for no-shows [58]. Indeed, three people did not reply to the scheduling messages and another one was not available to participate in the end. Therefore, the first focus group was conducted with four participants (1 non-player, 1 casual player, and 2 usual players) and the second one with five participants (1 non-player, 1 casual player, and 3 usual players). Finally, the study was conducted with a total of 9 participants, ranging from 18 to 57 years old, a heterogeneity that allows for broader perspectives but may limit generalization. A summary of the participants' profiles is presented in Table 1 for the first focus group and Table 2 for the second.

As can be seen, the sample was generally young, with 66.7% of participants under the age of 30, while the remaining participants were over 40. Gender distribution was not balanced, as women outnumbered men by a ratio of two to one. Regarding playing habits, both groups were designed to include at least one person representing each point on the spectrum: one participant who never played and therefore had little or no knowledge of video games, one who played casually, and one who was familiar with games because they played regularly.

5.2. Stimuli

After the first set of questions about gaming experiences in general, four stimuli were presented in order to test different approaches to E2U language. A text excerpt from the video game *Mass Effect* (Bioware, 2007) was used. It was part of a *codex*, a type of encyclopaedia containing information about the world-building and lore of the game. Given that the video game is set in a science fiction universe, there is added complexity due to the technical nature of the content. Specifically, this fragment presents a technological advancement that enables travel at the speed of light (see Table 3).

The excerpts were shown twice: first, the text was presented in its standard version, the original one from the game (S1), and then a

Table 1
Participants' profiles in the first focus group.

Participant	Age	Gender	Playing habits	Source
Participant Red	57	Male	Never	Disnavarra
Participant Green	44	Female	Never	Disnavarra
Participant Purple	22	Female	Every month	Disnavarra
Participant Blue	25	Male	Every week	acd

Table 2
Participants' profiles in the second focus group.

Participant	Age	Gender	Playing habits	Source
Participant Pink	24	Female	Never	Service for Inclusion
Participant Orange	18	Female	Every month	Service for Inclusion
Participant Gray	27	Male	Every week	acd
Participant Yellow	21	Female	Every week	Service for Inclusion
Participant Brown	51	Female	Every week	Disnavarra

Table 3
Excerpts in written form.

Standard version (S1)	Simplified version (S2)
Mass relays are feats of Prothean engineering advanced far beyond the technology of any living species. They are enormous structures scattered throughout the stars, and can create corridors of virtually mass-free space allowing instantaneous transit between locations separated by years or even centuries of travel using conventional FTL drives.	**Mass relays** are feats of Prothean engineering. They are advanced far beyond the technology of any living species. They are enormous structures scattered throughout the stars. These structures can create corridors of almost mass-free space. That way, they allow instantaneous transit between locations. These travels would take years or even centuries using conventional faster-than-light (FTL) drives.

simplified version following the easy to read and understand guidelines (S2) was shown to participants. Next, the text was presented twice in auditory form. First, participants listened to the recording of the first version of the written text (S3) and then to the recording of the simplified version of the written text (S4).

5.3. Procedure

The two focus groups were performed during summer 2024 via Microsoft Teams. Before the study started, each participant signed a consent form allowing to record the session and to use their responses. They were also informed about the project and the goals of the study, which had been approved by the Ethics Committee of the Universitat Autònoma de Barcelona (CEEAH 6796).

A protocol was designed to guide the sessions, with two sets of questions based on their theme. The first section, "About video games and user needs", included questions such as "Have you found difficulties when playing a video game?" or "When you play, do you use any accessibility options?" to gather positive or negative experiences with video games, as well as general preferences when playing. The second section "About easy-to-understand language" implied the presentation of the stimuli and questions related to their acceptability, such as "Which of the four options we have shown do you prefer?" Fig. 1 illustrates the flow of each session.

During the sessions, one of the authors undertook the role of moderator and the other one was the note-taker. The moderator adopted a directive approach, focusing the discussion on the pre-determined topics included in the protocol to elicit participants' opinions and experiences with video games and accessibility. At the same time, active listening was practiced using probing techniques to seek clarification, elaboration, and examples from participants [59]. Meanwhile, the note-taker wrote down the key points of the discussion to support later analysis and help to draw conclusions at the end of the session.

The analysis of the collected data was conducted primarily with the software Atlas.ti using thematic analysis. The steps outlined by Braun and Clarke [60] were followed. We started by familiarising with the recordings to gain an overall understanding of the discussions. Then the transcriptions generated by Microsoft Teams were reviewed and corrected using the video recordings as a reference. Interventions were annotated with specific markers, such as "[…]" for long pauses within an intervention and "(…)" for dialogue that was unclear or inaudible.

5.4. Analysis

An initial set of codes was created and then refined with subsequent analysis, resulting in a list of three themes, six categories, and twenty subcategories, as presented in Fig. 2. The figure also illustrates the relationships between the barriers reported by participants and the accessibility options they preferred to address them.

The first two themes, related to the difficulties of dyslexia in general and in video games in particular, were addressed in a different study [61]. Here we focus on the third theme, "Access to video games", which describes the needs of the participants, as well as their views on accessibility. Table 4 presents the categories and subcategories discussed in the following sections. These relate participants' insights with their preferences and their perspectives on accessibility, as illustrated by the excerpts. Interventions were originally produced in Spanish, but they have been translated into English by the researchers. To guarantee anonymity, the name of the participants has been coded with colours when quoting their interactions in the following sections.

For more information about the sessions and the data, a public dataset is available including the protocol, the transcription, the notes, and all relevant information [62].

6. Results

Results are presented according to the two main categories: accessibility and preferences. However, users' opinions regarding the stimuli, while also related to preferences, are included in a third section to highlight findings connected to the stimuli in E2U language. The presentation of findings moves from a general perspective on accessibility, through various user recommendations, and finally to the specific accessibility feature of E2U language.

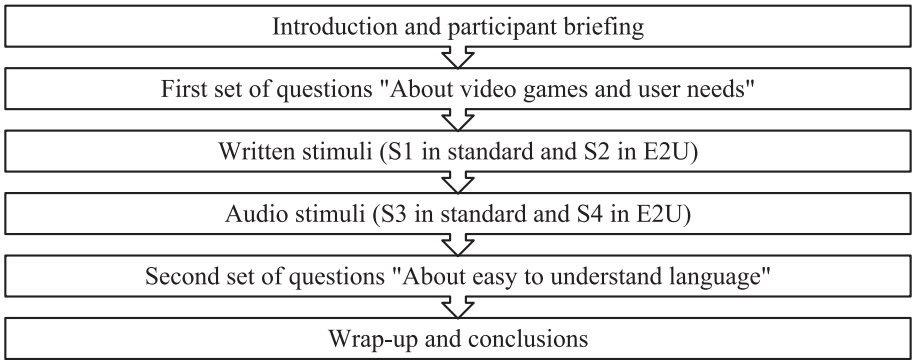


Fig. 1. Overview of the focus group procedure.

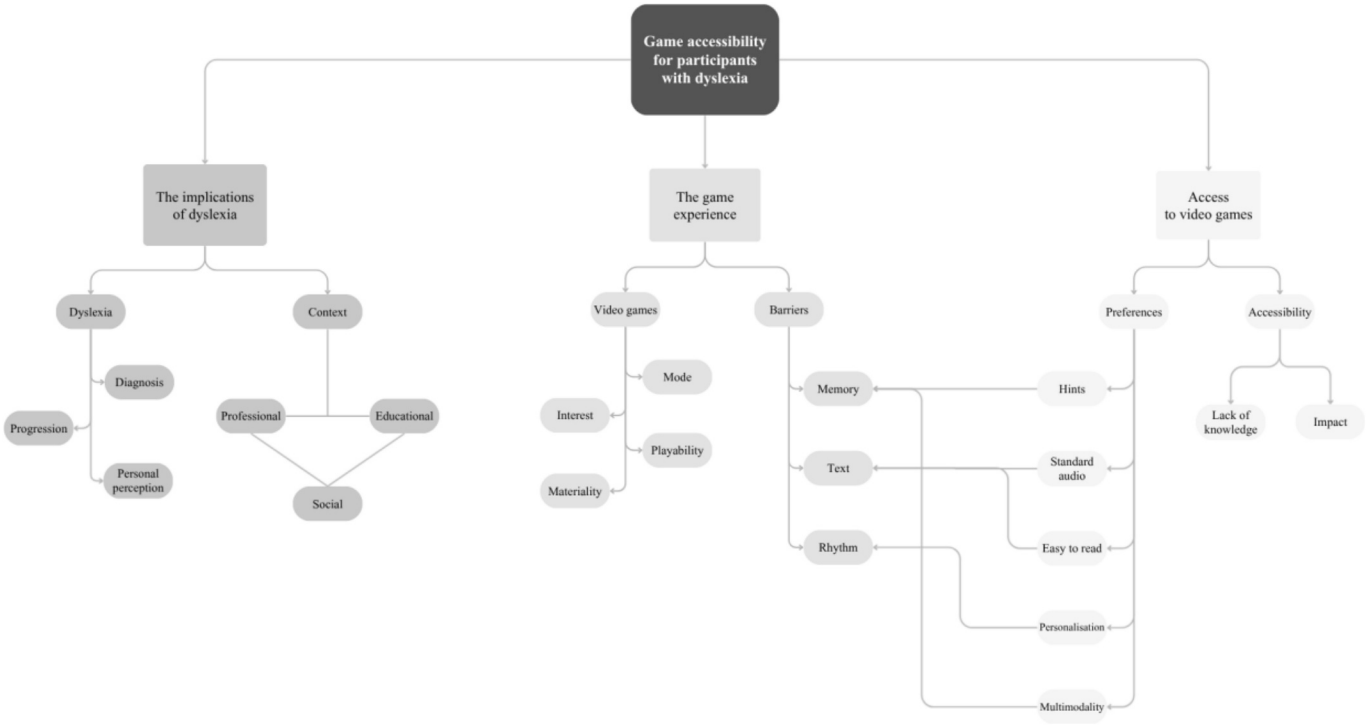


Fig. 2. Thematic map of participants' perceptions of game accessibility.

Table 4
Coding list.

Theme	Category	Subcategories	Definition	Examples (our translation)
Access to video games	Preferences	Hints	Repetitions or hints that prevent the players from getting lost or disoriented during playthrough.	"After they explain [important information] to you, [I would like to have] a summary sentence or something summing it up, in case I missed anything."
		Standard audio	Information transmitted through a natural, warm voice.	"That way of explaining it as if it were a person or something, it's not… I mean, it's not so slow, it's not so structured, but more like a conversation."
		Easy to read	Information conveyed in a clear and simple text.	"... you had the most important information highlighted, not just because of the bold text, but especially because of the paragraph breaks. The sentences were simple and easy to understand."
		Personalisation	Possibilities of the player to explore the game at its own pace and likeness.	"... the possibility of adjusting the speed could also be something to consider."
		Multimodality	Combination of channels (audio, text, image…) in order to provide an optimal understanding of the information.	"For me, [it is] especially [important] the fact that the text is in audio, I mean, that as it's being read, it's also being heard."
	Accessibility	Lack of knowledge	A lack of understanding about what accessibility is or how it is implemented.	"So, we might not even realise that there's something called *accessibility*, which tries to make games or things easier…"
		Impact	Transcendence and reach of accessibility.	"... that helps me, I mean, it helps me a lot and I think it helps everyone as well."

6.1. The scope of accessibility

In general terms, users showed a lack of knowledge of accessibility options, either because they thought they did not need them or because they never tried them. Therefore, game accessibility remains relatively underrecognised, as highlighted by the "Lack of knowledge" code.

On the one hand, our participants did use basic features on a regular basis, like subtitles, but may not have explored newer tools like screen readers or more common features, such as controls adjustment, as stated by Participant Pink: "And the [accessibility] thing about the controls, I didn't even know it existed". The words by Participant Gray are illustrative as a general overview:

> In fact, it's not something I had thought about much… and maybe others haven't either… I mean, people with dyslexia, […] it's not like we always know a lot about the topic. So, we might not even realise that there's something called *accessibility*, which tries to make games or things easier…

This might point to the necessity of more robust campaigns to raise awareness about accessibility in general and game accessibility in particular. On the other hand, those familiar with accessibility, as can be perceived from the "Impact" code, noted that its implementation in video games may be limited by the budget companies are willing or able to allocate for development and design, as exemplified in Participant Blue's intervention: "If all video game studios had infinite money […]. But since I know that's not possible." Other participants pointed out that certain accessibility features might present technical challenges or require changes that are difficult to implement. As Participant Gray puts it: "As an idea, it sounds great, but when it comes to actually implementing it... I think that's where the real challenge lies, right?"

However, most participants praised the accessibility advancements of recent years and are eager to learn about them. As awareness of

inclusivity grows, people are not only interested in benefiting from accessibility features, but also want to contribute to their development. In this sense, the beneficiary of accessibility becomes both an advocate and an agent of change, helping to expand access to more people. The idea that accessibility benefits everyone, not just those with disabilities or learning difficulties, is gaining recognition. In turn, this inclusive understanding fosters engagement, as shared by Participant Brown: "I'm older than you, and when I was your age, there was no accessibility of any kind. [...]. They didn't take anything into account. However, now that I'm older, I've gotten more into it because [games] are easier." If game developers approach accessibility effectively, including a variety of options can significantly enhance access to this type of interactive entertainment.

6.2. Players' needs and recommendations

Our participants were highly aware of their needs and preferences and expressed them openly. Most of their recommendations are closely related to the obstacles that a person with dyslexia might encounter. They offer simple ways to reduce frustration and improve accessibility, creating pathways for interaction and immersion in a safe environment.

The analysis of the "Hints" code revealed that reminders of relevant information can serve as an initial approach to mitigating barriers arising from memorisation. For example, a visual reminder of the controls could be included, as stated by Participant Purple: "If there was an image of the controller pointing exactly where you need to press, it would be easier, you know?" A summary of important information could also be provided after certain events, as suggested by Participant Gray.

Providing players with a wide range of options to personalise their gaming experience ensures that everyone can progress in a way that best suits their preferences and play style, as we observed in the "Personalisation" code. For example, developers can allow players to customise the controls, as described by Participant Orange: "The buttons, the reassignment, [that's important to me] because I'm a person of habits, and if I'm used to moving my fingers in a certain way…".

Video games can also allow players to adjust the speed of text and audio, as recommended by Participant Gray: "Maybe the possibility to adjust the speed could also be something to consider […], because sometimes we're more tired and want the text slower, and other times we want it faster." It would also be useful to include the option of modifying the difficulty, as preferred by Participant Brown: "I always set the difficulty level to the lowest, and as I progress, I gradually increase it once I get the hang of how it works." In general, participants would like to have the possibility to pause, skip, rewind, or repeat any game feature, as stated by Participant Yellow: "That you can go somewhere and press the button to repeat [a mission or tutorial], because sometimes it's not clear enough."

One of the most consistent demands of people with dyslexia is for information to be available through as many channels as possible, which we coded under "Multimodality". Instructions or dialogues could be presented in both written and spoken forms, as preferred by Participant Green: "[In some situations] maybe just the audio is enough, but if it's something specific, I also need it written down." Participant Pink agreed: "For me, [it is] especially [important] the fact that the text is in audio, I mean, that as it's being read, it's also being heard." The written message could also be complemented with visual elements such as icons or symbols, as described by Participant Blue: "Even adding a little mark, like an ideogram of what the object is, like a little tree, a little animal."

6.3. The use of easy-to-understand language

Regarding the stimuli presented, the results indicate that difficulties in texts for individuals with dyslexia arise only in written form. Specifically, there was a clear preference for E2U language in the written stimulus (S2), compared to the indifference or even preference for the standard version observed in the audio stimuli (S3).

All nine participants preferred the written text in E2U language (S2), a pattern we captured within the "Easy to read" code. In terms of text, our participants expressed a preference for specific writing and formatting styles: short sentences with easy, clear terminology, as indicated by Participant Green: "The lines were simpler, clearer. Full stop, another idea, full stop, another idea, so that way it kind of helps you orient yourself, it guides you" and Participant Pink: "So, by making the sentences shorter and separated, it's easier to understand." Important words could be highlighted in bold, as suggested by Participant Purple, and the typography should be sans serif and generally designed for optimal readability, as noted by Participant Blue: "Maybe fonts that are not so... square, but ones that make it easy to understand what each letter is."

With regards to the audio, the E2U language version did not have a significant impact (S4), as it was perceived as very similar to the standard one (S3), although the latter was generally preferred, as we conceptualised in the "Standard audio" code. Participants preferred a recording resembling natural conversation, as stated by Participant Purple: "That way of explaining it as if it were a person or something, [...] not so slow, [...] not so structured, but more like a conversation." Participants also liked the audio that did not include many pauses between interventions and had a good rhythm, as described by Participant Yellow: "By going a bit faster, it gave me time to remember everything."

Among the stimuli shared with them, there was a clear preference for written E2U texts and standard audios, evidencing that difficulties emerged in reading the information, while the same content in audio format was easily processed. In any case, the ideal scenario would involve a combination of both written and aural information, along with the possibility to switch between them.

7. Discussion

In a previous part of the study [61], dyslexia was defined as a learning difficulty that affects multiple aspects of a person's life. If participants struggled to meet the skills demanded by the education system, they often perceived themselves as having a problem, especially before diagnosis. Therefore, early and accurate identification can help mitigate these challenges, enabling the development of reading skills.

Video games provide our participants with both positive and negative experiences. For some, they offer a refuge from academic pressure and fear of judgment. For others, however, they replicate the same barriers of daily life: text-heavy narratives, fast paced gameplay, and difficult-to-memorise controls can make video games frustrating rather than entertaining.

However, there are several ways to create games that our participants can enjoy. To avoid obstacles arising from memorisation, the Game Accessibility Guidelines [13] and the Cognitive Accessibility Guide [16] suggest including reminders of current objectives and controls. A good example of this practice appears in *Assassin's Creed Unity* (Ubisoft, 2014), which includes a reminder of the controls in the top-left corner of the interface, displaying each button as it appears in the controller. The Accessible Player Experience model [14] also advocates for the ability to access help information about how any feature or interface of the game works at any time. Such assistance could also be provided through pop-up windows [17] or indicators and arrows [18]. An example that could serve as a reference is *Super Mario Odyssey* (Nintendo, 2017), in which players may choose to be guided by blue arrows on the ground, which can be followed to reach the next goal.

Participants also expressed a desire to play the game at their own pace and under their own conditions, to create a more personalised experience. To that end, challenges, instructions, tutorials, and anything related to the narrative could be replayable, rewatchable, or rereadable [11–13,16,17], so that players can improve skill-acquisition. A game that effectively implements this approach is *StarCraft II* (Blizzard Entertainment, 2010), in which cut scenes can be replayed as many times as needed.

To ease the adaptation of players to the flow of the game, many elements of a game can be made customisable: speed, controls, and difficulty [13–15,18]. An example of a game that adapts its difficulty is *Hades* (Supergiant Games, 2019), a rogue-like action game with a God Mode option that increases the player's damage resistance to experience the story more easily. Another feature that could improve accessibility is the option to disable certain stimuli that are not essential but may increase cognitive load [17]. A good practice might be to offer a low-detail background, as seen in *Street Fighter IV* (Capcom, 2008), where combat arenas are rendered as a black backdrop, making the playable characters easier to distinguish.

One of the features participants found most useful was the ability to convey information through multiple channels. Multimodality can be granted via reinforcing textual information, especially instructions, with visual and audio cues [13–15]. In *Rise of the Tomb Raider* (Crystal Dynamics, 2015), for example, the main character orally describes every object she acquires, while a written description can be read at the same time. The XAG [15], along with the IGDA-GASIG [18] guidelines, also highlight the importance of providing text-to-speech and speech-to-text technologies. Some authors also recommend using symbols or visual icons [63], which could benefit people with dyslexia, as they seem to comprehend non-linguistic items better than words [64]. This approach is exemplified in *Grounded* (Obsidian Entertainment, 2022), in which every menu tab has a written title alongside a symbol representing its content, such as an icon with a burger and a cup in the "Meal prep" section.

Nonetheless, perhaps the most important feature for a person with dyslexia would be controlling the time spent reading. To that end, developers are encouraged to provide players with the option to pause the game when text appears [11]. This approach was already considered in early video games, such as *The Legend of Zelda: Ocarina of Time* (Nintendo, 1998), where text remains on the screen until the player presses a button to continue.

Regarding multimodality, two important considerations must be taken into account. First, people with dyslexia tend to perform better at categorizing acoustic cues [65], so they would prefer audio among available channels. Second, visual information can both hinder and help learning [66], meaning that all stimuli or information sources should be balanced to ensure that people with dyslexia can correctly receive and understand information. In line with this, participants' preference for the auditory stimuli we provided appears logical. Some preferred it over the written texts, although the majority expressed a desire for a combination of both auditory and E2U text.

With respect to E2U language, the preference for the written text in E2U (S2) was anticipated. Simplifying written text has been widely recommended by non-academic sources, emphasizing clear, simple, and easy-to-read language [17], proper formatting with highlighted words [13], and short sentences [16]. There is also empirical evidence showing that such simplification can improve readability for people with dyslexia, although none of the sources we reviewed explicitly mentioned E2U language. Rello et al. [67] demonstrate that frequent words enhance reading speed, and that short words improve understandability. Schematic information [68] and word highlighting, especially with a blue background [69], have also been shown to improve readability.

These written features, along with participants' suggestions regarding audio, such as using a warm voice, a natural dialogue style, an appropriate speech rate, and well-timed pauses, align with recommendations for easy-to-understand language provided by both Inclusion Europe [47] and the ISO [43]. This suggests that several accessibility features valued by participants with dyslexia reflect E2U principles that have not yet been systematically implemented in video games.

The text font deserves separate mention due to inconsistencies between recommendations and empirical evidence. Both Cassidy [16] and Brown [17] suggest incorporating fonts like OpenDyslexic, which was specifically created for people with dyslexia. However, research indicates that this font does not improve readability [42], nor do similar ones like Dyslexie [41]. These fonts appear to be based on the symptom of letter reversals. Nevertheless, as previously mentioned, dyslexia is often linked to a weakness in alphabetic and phonological decoding [22]. Therefore, rather than relying solely on these types of fonts, developers should follow recommendations for an easy-to-read font. Readability can be improved with non-italic or Roman, sans-serif, and monospaced fonts, such as Helvetica or Arial, especially in digital environments [70]. Additionally, the fact that these purposely-designed fonts may not work for all players with dyslexia reinforces the importance of a linguistic approach, such as implementing E2U language, to support readability and comprehension.

To conclude the discussion, several limitations of this study should be acknowledged. To begin with, the experiences, needs, and preferences of nine participants cannot represent the broader community of players with dyslexia. The fact that thematic saturation was not reached also poses challenges for identifying consistent patterns that could be generalised. However, this study operates at a level of transferability [71], since it is expected that future research can build on these insights and that some individuals may find this information useful for their circumstances.

On the one hand, the confounding variable "playing habits" was partially controlled through a blocking design, but the gender imbalance and age heterogeneity of the groups remain threats to external validity. On the other hand, the fact that participants encountered the same text across four consecutive stimuli, even in different modalities, may have introduced a learning effect, affecting their preferences. However, using a different text for each stimulus could have introduced biases related to the content, while complete counterbalancing was not feasible, as it would have required four presentation orders that could not be implemented with only two groups. Therefore, the focus was to explore participants' perceptions through qualitative findings rather than assessing causal effects.

Furthermore, during the stimuli phase, technical issues prevented one participant from properly receiving the audio and another from reading the text. Given the presence of other participants in the call, representing the stimuli to the entire group could have further influenced their opinions. Therefore, these two participants provided their responses based on the information available to them, which may have been influenced by others' views.

Despite these limitations, we believe the results of the study are promising. They indicate that E2U language, which was positively received and preferred by all participants, has the potential to enhance cognitive game accessibility for some players with dyslexia, although further larger-scale studies would be necessary to confirm these initial results.

8. Conclusion

Game accessibility has been rapidly expanding in recent years, yet accessibility for players with dyslexia has received little academic attention so far. This paper has presented a study about the needs and preferences of individuals with dyslexia when playing video games, and about the potential application of E2U language to improve their gaming experience. E2U language is being increasingly applied in websites and in audiovisual texts, but it has not been applied to video games yet, although it could potentially enhance their cognitive accessibility. Following a user-centred approach, two focus groups, with four and five participants respectively, were conducted to elucidate their needs and preferences regarding video games and garner their opinion about the use of E2U language in video games, both in written and oral form.

Results show that while games might be widely regarded as an escape from reality and a source of enjoyment by most players, they can replicate frustrating real-world barriers, at least for our participants with dyslexia. Some of them were not familiar with game accessibility, although they used certain accessibility options, such as control remapping. They valued some features commonly present in video

games, such as difficulty adjustments and subtitles, but expressed a desire for greater personalisation, reminders, and hints. To address dense and hard-to-read text, they advocated for simple sentences, a clear hierarchical structure, and a format that emphasises key information, which is precisely what E2U language provides. And when gameplay is fast-paced and difficult to follow, they favoured a pace that adapts to the player.

Regarding the stimuli presented in standard and E2U text and audio, there was a clear preference for E2U language in written form. However, this accessibility option did not have a significant impact on its auditory version, which was perceived as very similar to the standard one, although the latter was generally favoured. These findings suggest that E2U language has the potential to enhance game accessibility for players with dyslexia and warrants further investigation through larger-scale reception studies. The next phase of the research will involve conducting a reception study using a video game featuring E2U language to assess whether and how this type of language impacts the gameplay experience for players with dyslexia.

To conclude, we believe that positive experiences with video games can boost interest for this form of entertainment among individuals with dyslexia, which, in turn, can drive demand and create new market opportunities for developers. Game accessibility can transform obstacles into gateways, allowing video games to stand as symbols of inclusion in the digital society.

Video games

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CRediT authorship contribution statement

Miguel Ángel Oliva-Zamora: Writing – review & editing, Writing – original draft, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Carme Mangiron:** Writing – review & editing, Writing – original draft, Supervision, Project administration, Investigation, Funding acquisition, Data curation, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Data availability

All data collected and analysed in this study are available in a public dataset [62].

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