Deaf Play: Social Play and Signed Communication among Deaf Gamers in Co-Located Environments

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Co-located multiplayer gaming experiences feature continuous, low-effort verbal communication, creating hidden barriers for Sign Language Users. Prior work on mixed hearing-deaf groups documents multimodal communication strategies; combining spoken communication, non-sign gesturing, and text-based chat systems. This leaves a gap in our understanding of how communication occurs in non-spoken contexts, where text-based modalities are impractical such as for groups composed of only sign language users in co-located environments. Without understanding these contexts, designers risk excluding d/DHH players from social experiences in games. We present an observational study of primary sign language users to show how two interacting constraints, manual encumbrance on the hands from having to hold the controllers, and competing visual attention between players and on-screen play, affect Deaf communication in a co-located gaming environment. We introduce a model describing how Deaf players negotiate attention, encumbrance, and communication timing during co-located play.

Deaf, BSL, Accessibility, Games, Social

1. INTRODUCTION

Many video games are created to help foster a social connection between players. A wide variety of social gaming experiences (Gonçalves et al. 2023) exist to satisfy social needs, abate loneliness (De Schutter and Vanden Abeele 2010), and connect with family and friends (Osmanovic and Pecchioni 2016). Cooperative and competitive multiplayer games assume continuous, low effort verbal communication between players while playing the game (Depping et al. 2018, 2016; Nardi and Harris 2006). This assumed standard of communicating is treated like a gameplay mechanic. For example, through direct interaction with the game in 'phasmaphobia' (Kinetic Games 2020) where players must speak to ghosts using a microphone and listen for the ghosts responses; or through indirect team based interactions, such as in the Multiplayer Online Battle Arena Genre, where continuous communication is shown to improve gameplay outcomes Buchan and Taylor (2016).

For users of signed language, continuous communication throughout gameplay does not hold. Holding a controller encumbers the hands and competes with the need for free hands for clearer signing, while the need for constant visual attention on the screen competes with the visual attention needed for signed conversations. This introduces a tension for Deaf players: the choice between gameplay and communication.

We conducted an observation of 14 British Sign Language (BSL) primary language users playing on co-located console games in small groups to examine a) how communication constraints manifest, and b) how they combine to create a distinctive Deaf gaming experience. By analysing how Deaf gamers coordinate, strategise and interact in these contexts, we characterise the structural barriers that limit social and game-based communication in co-located scenarios, enumerating implications for design that could mitigate these barriers and improve Deaf players' experiences.

Our work addresses the following research questions:

- **RQ1:** How does using a signed language affect the form of communication during co-located play?
- **RQ2:** What communication strategies emerge among Deaf gamers playing together?

To the best of our knowledge, this is the first study to observe how a group of entirely Deaf Sign Language Users (SLUs) play games in a natural social environment using predominantly signed communication methods.

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2. RELATED WORK

2.1. Social Gaming

Gonçalves et al. (2023) define social gaming as "a shared activity where people can spend time together, communicate, and socialise". It is important for emotional well-being; research has shown that friendships through gaming can offer strong emotional support, and companionship (Depping and Mandryk 2017). For some, these places can serve as one of the few informal public spaces where social bonds can be formed. Co-located multiplayer games (colloquially "couch co-op") can foster face-to-face interaction, and build upon teamwork skills (Powell and Kaye 2019). These physical shared spaces allow players to discuss the gameplay, respond to non-verbal cues, and have spontaneous non-gameplay based conversations that extend beyond the standard gaming experience.

2.2. BSL and deafness

The d/Deaf and Hard of Hearing community (d/DHH) includes a wide range of people with significant differences in their hearing loss, identities, and communication practices. Within the UK, the *Deaf* community – those whom share similar life experiences and language – often uses BSL, often with regional variations (Sutton-Spence and Woll 1999; Stamp et al. 2014).

Inclusion of various parts of the d/Deaf communities in video games has been the focus of previous work (Theil et al. 2023). However, as with other communities and people with disability, many disabled gamers want to partake in online gaming but often choose to play alone (Baltzar et al. 2023; Beeston et al. 2018), reporting a wide range of reasons, including lack of connection to other players and accessibility issues. These particular issues are extended to SLUs who use a different communication system entirely.

Sign languages, like BSL, are fundamentally a spatial-visual system conveyed through handshape, movement, location, facial expression, and body posture (Battison 1978). For many Deaf individuals, it is their primary, preferred, or only language. Though BSL is a primarily two-handed language, there is variation including single-handed variants (Sutton-Spence and Woll 1999).

Battison (1978) describes how physical barriers, including those that occupy two hands,eg, when holding an item, do not stop signers from communicating. However, signs are altered to accommodate for the reduced availability and to maintain legibility and comprehensibility. This is done through a process called 'weak drop'. Signs that encounter weak drop, or other morphological changes due to barriers, may also suffer semantic and recognition changes. In gaming contexts, players must have some form of interaction with their controller, often requiring both hands. In these situations, weak drop is more likely to occur and so misunderstandings are more likely to occur.

Signers' understanding may be inhibited further when put into non-optimal visual sight-lines. The legibility and efficiency of signed communication relies on unobstructed visual access (usually sustaining a frontal or near-frontal viewing angle), and space for articulation (Watkins et al. 2024; Naeve et al. 1992; Emmorey et al. 2009). This is best explained through the term 'Deaf Space' (Byrd 2007). This architectural term explains how when deaf people are together, they work to re-arrange furniture, lighting, and positioning to optimise for visual communication and reducing eye-strain. Standard conversation patterns for a pair is to position directly opposite for best eye-contact, or when in a group of people, to create a "conversation circle". When one person or element is more important in a group, people often move into a semicircle opposite the dominant element (Tapio 2018). This is especially relevant to co-located game contexts, where players must balance multiple visual aspects around the room, including the screen and a varied amount of co-players.

2.3. Game communication

Video games often provide options to assist communication for players, such as; voice chats, text chats, and in-game non-spoken communication like, pings and emotes. For hearing players, voice is often the default communication method, whether playing casually or in high stakes scenarios (Wadley et al. 2014; Kostrna and Otalora 2025; Depping et al. 2018). Though text chats remain widely available, they can be less efficient in fast-paced play, where typing disrupts the flow of action (Lee et al. 2025). Game specific systems, like pings, emotes and radial dials provide lightweight –often single button– methods for directing attention or signalling intent (Leavitt et al. 2016; Wuertz et al. 2017). These are useful supplements, especially in team based genres like the Multiplayer Battle Online Arena (MOBA) genres. However, these methods are unable to convey nuance, or provide clarifications (Kostrna and Otalora 2025), which can lead to more miscommunications.

Recent work examining d/DHH players has begun to highlight the challenges of communication for d/DHH people in social play contexts. For example, studies of mixed d/DHH groups in co-located augmented reality settings show that participants employ a range of multi-modal strategies to maintain coordination (Luna et al. 2024). In pre-game phases, where longer, more intricate discussions were required, tools like speech-to-text applications were employed, whereas during gameplay, and in latter rounds where strategies were already devised and agreed upon, communication settled on gestural and body language, focusing on simpler interactions. Luna et al. (2024) describe how designers

can facilitate this communication within their games by implementing richer visual feedback and live speech to text, mitigating some of the barriers between verbal and signed communication. Bridging the experiences of hearing and d/DHH gamers then relies on a mapping of different modalities into a mutually intelligible space.

To address our research questions, we conducted a series of discussion and observation sessions with Deaf signers in co-located gaming environments. Through these sessions, we examined communication practices, and gameplay interactions within shared play environments, alongside their reflections on social play and communication.

3. METHOD

3.1. Participants

We recruited 14 Deaf participants from a Deaf-focused college. All participants were aged between 16-25; were fluent in BSL and used it as a primary language; had prior experience in gaming; and were familiar with their co-players. Participants were offered a £45 voucher as compensation for their involvement. Given the potential vulnerability of some of the participants, the research went through a full ethical review as part of our institutional review process. Participants, and where necessary parents or guardians, gave informed consent and were aware of their right to withdraw at any time.

3.2. Materials

The first session involved co-design to drive discussion on players experiences in game situations, such as with various game mechanics and communication techniques and strategies, candidate game titles were provided. It provided a basis to derive materials and activities used going forward; namely using lego to create representations of the layout of the physical space d/Deaf players like to play games in. This detailed the spaces in which they commonly played games, how they design those spaces, and how the spaces available for the study could be best curated for their needs. This provoked discussion on communication systems in games, including critiques and exemplars, which helped to further curate the study design for the later sessions.

To ensure clarity and facilitate participant input, we introduced a procedure termed 'sign-commenting' – an adaptation of the 'think-aloud' protocol designed for Deaf BSL signers – at the beginning of the study and at the start of each subsequent day. This served two primary purposes: to clarify how we will conduct the observation sessions, allowing for methodological refinements. Discussions during sign-commenting sessions addressed researcher questioning strategies, including the types of prompts intended and the desired style of inquiry. A key methodological adjustment resulting from these discussions was the inclusion of explanatory glossaries defining slang, non-lexical signs, and iconic signs encountered during the research. Given the limited availability of established BSL signs for many games and related terminology, participants collaborated with communication support workers (CSWs) and researchers to develop accurate and culturally appropriate translations. This involved clarifying proposed sign names and discussing the iconic elements employed in conveying meanings, contributing to the consistency of translation throughout the study.

In relation to the sign-commenting methodology, participants discussed how the discontinuity of the conversations – needing to place the controller down on a surface in order to sign and communicate with the researcher while playing – could affect communication and concentration. Questions requiring more in-depth discussion or consideration were therefore more appropriately left for pauses in gameplay.

The study apparatus consisted of a large display (~52"), connected to a Sony PlayStation 5 video game console. The console was connected to a desktop computer for recording purposes A camera was used to collect high quality video of participants from a front angle. This allowed for viewing of participants facial expressions and signing when facing towards the display, as well as how they interacted with the display. Audio was also recorded, alongside observational field notes to document the complete communication space within the context of the study.

The games played by participants were available on the PlayStation 5, allowed for local cooperative play with multiple controllers, and chosen based on discussion from the first day's co-design session. These were chosen to elicit various circumstances of communication amongst players, such as where communication overlapped with consistent physical, visual, and mental demands of gameplay. A variety of games were played by participants, with two being main re-occurring games that provide the focal point of data collection and analysis. These were *Overcooked* (Team17 Digital, Ghost Town Games 2021), and *Stickfight* (Landfall West 2017). Other games played to a lesser extent and analysed included; *Fortnite* (Epic Games 2017), *Trials: Fusion* (RedLynx, Ubisoft 2014), *Tekken 8* (Bandai Namco Studios 2024), and *Golf With Your Friends* (BlackLight Interactive, Team17 2020).

3.3. Procedure

Sessions ran across 5 days, each lasting for approximately 5 hours including breaks. Day 1 was initial Co-Design and discussion with a large group of participants. The rest engaged participants in smaller groups [2-6 players], where the adapted sign-comment methodology was implemented for gameplay sessions. This included

direct observations, semi-structured interviews, and discussions with participants. Communication Support Workers (CSWs) from the College attended each of the sessions, supporting participants, and to assist in any clarification in discussions or task instructions.

We annotated the dataset using ELAN (Lausberg and Sloetjes 2009), a software package for complex video and audio annotations. The timeline was annotated with; Moments of communication, descriptive annotations of player actions, players primary focus, and in-game events. This allowed us to view the methods of communication, when and how they occurred, and the context surrounding that moment of communication.

4. FINDINGS - MODEL OF COMMUNICATION

We identified recurring patterns of how attention was coordinated, how visual and physical resources were managed, and how games hinder effective communication for SLUs. Our analysis reveals that communication during Deaf gameplay, and the creation and use of shared communication windows is shaped by competing attentional resources. These physical and visual resources, integral to both interacting with the game and for signed communication, are continuously renegotiated under a shared game-space. The inability to partake in simultaneous communication methods during gameplay, participants engaged in ongoing assessments of *when* to communicate, *how* to do so, and *whether* communication was feasible at all, given demands of the game. We show that games hinder effective Deaf communication, placing directly competing constraints for visual and physical attention. However, we also show that the inability to communicate hinders effective gameplay, especially shown in games where teamwork and coordination are required.

To present our findings, we have synthesised them into a model of Deaf communication and interaction in video games. We present Figure 1, which conceptualises Deaf play as a sequence of attention based demands, decision-making processes, and presents potential communication outcomes. This model represents observable interaction patterns found within Deaf communication and gameplay, capturing dynamic relationships between visual attention, physical load, positioning, game demands, and communication intent. The model was derived inductively from repeated viewing and annotation of gameplay footage, and notes, grounded in specific moments, rather than imposed in advance. This model shares similarities and draws upon previous works in communication theory (Gioiosa Maurno et al. 2024; Rukšėnas et al. 2014). It is also based upon previous literature on the modelling of standard signed communication practices, such as the patterns in turn taking (Coates and Sutton-Spence 2001; Sutton-Spence and Woll 1999) We also draw from multiple resource theory (Wickens 2008), which characterises visual and manual attention as limited resources. We apply this framing specifically to the case of signed communication, where visual and manual resources are required for language production and reception.

The following section unpacks its components with reference to empirical examples from our data.

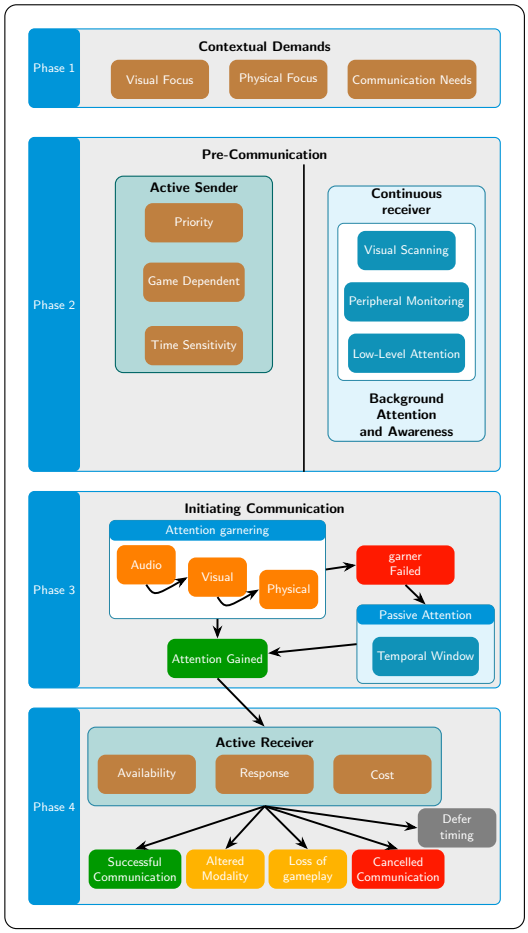

Figure 1: *MDCI: Model of Deaf Communication and Interaction*

4.1. Phase 1

Phase 1 describes the pre-existing demands upon Deaf players which characterised their communication and interactions due to their internal conflict with each other. **Visual Focus** was occupied by gameplay elements such as tracking players, reading on-screen information, and monitoring game-state changes. **Physical focus** required sustained engagement with controllers, particularly during high intensity moments of gameplay. These balanced against the players **Communication needs**. These needs arose throughout various points of gameplay, ranging from critical gameplay based information, to social interaction, and commentary. Participants encountered situations where Communication intent emerged precisely as visual

and physical demands reached their peaks, creating moments of conflict between players.

4.2. Phase 2

Phase 2 describes the two sides of player interactions in the time before any formal communication began. This describes how players are continuously receiving communications; and when players will try to begin a bid for attention or send a communication.

When looking to send communication to other players, an **Active Sender** would engage in a layer of processing to determine how and whether they should communicate. **Priority** refers to the perceived importance of the message relative to other information being communicated. **Gameplay Dependent** information reflects whether successful gameplay depended on shared understanding and information. **Time sensitivity** refers to how long the information remained relevant to the group and/or gamestate. **Quantity** of information influenced the perceived feasibility of communication, players were likely to defer communication if the message required an extended explanation.

A **Continuous Receiver** is the level of awareness and amount of background attention given by a player to communication at any given time, including moments outside of active communication where the primary focus is on gameplay. **Visual Scanning** describes moments where players would remove their primary focus from the game for a short period of time to look around the room. Players did this to quickly 'scan' their co-players to identify if communication was ready to start of if there was a current bid for attention. **Periphery monitoring** The monitoring of players periphery was necessary to receiving visual vids for attention. While keeping their primary focus on the game screen, players would often move into positions with a shared periphery to allow for easier access for visual bids. Players also presented a **Low-Level of Attention** that was given to all other players throughout gameplay. This amount of attention varied depending on the player, game, and timing. For example; players whom were in a leadership role in-game would have a higher level of attention given to them by all players

4.3. Phase 3

Phase 3 describes the initiation of communication. This describes the garnering of attention, whether through a bid by an active sender or through a shared temporal window. These bids for attention were player-led moments, where senders would create a bid for attention to their receivers, attempting to take attention from the game-space. Low priority or non-time sensitive information was seen to be deferred to the next moment of low/no interaction, as described by the temporal window. When an active sender has decided to initiate communication, they will decide on how to bid for a player's attention. We identified that the type of bid changed dependent on the information being passed along, as described within the 'active sender'. These bids usually aligned with moments of lower intensity gameplay, but for higher priority or game dependent information, would be more immediate. Senders would try to activate a receiver from background attention, described in phase 2, using these bids. If this failed players would either attempt another bid, often in another format, or accept the failed garner and await the next temporal window. If the bid is noticed by the intended player and attention is garnered, the communication would move into phase 4 which decided whether the information is passed.

Audio — Many who are Deaf may still have some form of hearing, or were wearing devices to assist their hearing, as was the case for some of our participants. Participants came across many occasions where signed communication was an impossibility, and so would use some form of oral communication. For our participants, an oral shout to garner attention was a common method to attempt during highly time-sensitive bids. This was often used in situations where shared awareness was high, or very little signed communication was needed; players just needed to draw attention. However, some participants were less likely to notice these bids, such as P11 who chose not to wear their cochlear implants during their sessions.

Visual — One way to garner attention for Deaf people is to visually signal inside their field of view. This was most commonly seen as a wave of a hand. This was effective at activating a receiver whom would share a periphery with their co-players. As this is a standard way to garner attention for Deaf people, this was the most common and effective strategy, as players were continuously monitoring for these types of bids. Players also used diegetic bids throughout gameplay sessions (i.e. composed entirely within the game-space), using in game communication systems or character based bids akin to character blocking and minor griefing of gameplay. This was primarily shown in 'Fortnite' where players could place a ping in the gamespace with a short pre-attached message which would work as both a bid and as the passing of information. Character based bids, such as that shown in 'Overcooked', often used to bring attention to something with a shared awareness, e.g., spinning a character in circles next to an important item to imply another player should help them. These diegetic bids often worked off of a shared awareness and didn't require players to remove their attention from the game to pass information after a bid was successful.

Physical — Physical modalities, ie, touching another person on the shoulder, were used on various occasions.



Figure 2: *An image of participants garnering attention*

This was often used as a last attempt, such as when the receiver has ignored previous bids in other modalities, but the sender feels the information too important to be delayed or ignored. This is commonly shown through a polite tap on the shoulder, but we also viewed this as someone tapping their foot on a players leg.

In Figure 2, we see a moment where these garners are used in quick succession. We see P11, positioned close to the screen, shout for attention of other players, then wave their hand to get the attention of those who missed the shout. Still unable to get the attention of one other player (P5), P11 asked P6 to tap them to get their attention which gets them to look up and discuss.

Game Defined Windows Players used game defined windows of opportunity to spark moments of communication. These natural occurrences provided a structured moment to allow all players to visually scan the room to notice passive bids for attention, that have awaited this temporal window. Players would often use these moments to check in with each other, looking towards players they intended to start a conversation with. For example, in versus games, the primary player of attention was the winner of the round. These windows of opportunities, like downtime between rounds, were often generated and managed by the game, not by players. This window often sparked conversations but limited their time-frame; causing abrupt endings to conversations, or shorter bursts of communication. However, players would use the game window as a spark to start conversation, but continue that conversation into the next moment of gameplay. This would cause them to sacrifice game interaction in the next game-moment, essentially forfeiting in-game in favour of continuing the conversation. Some of these windows were sparked by players, such as pausing the game being played, but they incurred a toll upon the game or other players. However, for some games, this would not pause the game for all other players, or like in 'overcooked' could ruin the flow of gameplay. On some occasions, this was met with exasperation from other players who were annoyed at their game being paused, especially those who were not the intended receiver.

4.4. Phase 4

Once a bid has been noticed, receivers engaged in another layer of processing. Eye contact is important to Deaf conversations, so the acceptance of a direct bid was shown simply through players looking at each other. This determined whether the communication attempt was accepted, deferred, or entirely rejected. **Availability** refers to whether the player has sufficient resources (primarily visual) to notice and negotiate a Communication bid. Even when communication was attempted by the sender, it could go accidentally, or purposefully, unnoticed if the receiver's attention was tightly bound to the game. **Cost of attention** refers to the perceived disruption caused by shifting focus away from gameplay. Players assessed whether attending to communication would negatively affect their performance or lead to in-game failure, and whether that trade-off was worth it. **Response readiness** reflects situations in which the receiver could technically receive the information but could not realistically act on or respond to the information. Knowing this, some players would actively ignore their counterparts until they were ready to respond. Participants would often wait for moments of lower intensity to accept disruption, such as when doing a repetitive action that required less visual attention to the game.

We identified five general outcomes from bids for communication: *Successful Communication*, *Altered Communication*, *Trade Off in Communication*, *Delayed Communication*, and *No Communication*. **Successful communication** happened when both sender and receiver were able to align their attention sufficiently for the exchange to occur. **Altered Modality** describes the various scenarios in which communication occurs in a non-standard manner. This commonly presented for our BSL users in one-handed signs. In situations where players only needed minimal interaction with the game, which could be completed with one hand, they would use the other hand to sign amongst each other. However, we identified times where these signs were misunderstood by the recipient, especially when sat in off-angles, leading to a non-successful communication attempt. Despite communication or gameplay costs, players still chose to communicate in some high gameplay demand circumstances. These situations resulted in **Loss of Gameplay/Reduced Communication**, where some form of communication was achieved but required sacrificing gameplay performance for one or more players, or sacrificing quality or quantity of communication. These trade-offs were common to situations with highly interdependent or time sensitive communication. We identified more significant information was amended to be shorter bursts relying on a shared awareness of the game, such as pointing to an important item in game and assuming players

knew the correct interaction, rather than directly signing the name of what item was needed and how it was needed. We identified moments of **No communication** where a player would attempt a bid for communication but would retract it upon a failed bid. Players would also perform a visual scan of the room to identify whether a bid was possible, and upon noticing that no bid was currently possible, would return their entire focus to the game and not continue their bid. These scans were frequent and short, but with enough time available for the player to scan the room. This would put the players attempt at communication back to phase 2, where players would re-assess the priority of the communication. We identified occasions where, even at the next major temporal window, the bid was not brought up again and thus was entirely dismissed. **Delayed communication** was a common situation amongst our data collection, where players would wait before engaging in any communication. For senders this would happen during moments of high physical focus, as they were not able to put down the controller to encode the message. This would then push the players' communication into passive attention of Phase 3, where the communication would await the next relevant temporal window.

In the next section, we provide some examples of our model applied to games played in our dataset as a way to understand the d/Deaf player experience.

4.5. Exemplars

Stick Fight, a fast-paced 2D brawler for up to 4 players, focuses on quick, near continuous rounds of casual player vs player matchups. In phase 1, the visual focus is high, with players having to keep track of themselves, the 3 opponent players, and weapon spawning across the map at any given time. This is matched by a high consistent physical focus; players must constantly defend or attack other players, only granted respite for a short 5-second break between rounds, or upon their death in the current round. In typical Stick-fight gameplay, communication is focused on casual, relaxed styles like taunting, or celebrations, though there were irregualar, short conversations about new abilities, weapons, or map gimmicks.

In Phase 2, pre-communication manifests with players adopting the continuous receiver role, keeping an eye on the other players for celebrations, to join in on jokes with each other and share those moments. There is less active sending of information where players would look to interrupt gameplay. In our observations, one instance (4 players; A, B, C, and D) of a player transitioning from the continuous receiver to active sender occurred when the game added a new weapon that would spawn snakes, which confused some of the players. This caused one player (A) to decide the need for understanding this new gameplay mechanic was important. Though this information had a lower time sensitivity, it had a high gameplay relevance, as they were placed at a disadvantage until they could communicate with other players. This resulted in their being knocked out of the round quickly along with another player (B). This meant both could immediately perform a bid for attention as a temporal window for communication had started.

As players were sat in a closer arrangement, a visual attention garner was chosen. With the other player knocked out, B noticed the bid more easily and the garner succeeded. Another player (C) still participating in the round also noticed and acted as an active receiver (see Phase 4). However, they decided they were unavailable to converse at the time, returning their focus to the game. The conversation between A and B about the snakes continued, with C and D joining the conversation at the next temporal window at the end of the round.

Stick-fight has limited temporal windows for communication, but its fast, casual nature allows for a better Deaf communication: in the instance discussed previously, players A, B, C, and D decided that loss of gameplay was less important than having conversation leading to fewer cancelled communications. Despite high physical and visual focus, the short temporal gaps after each round allowed players to celebrate or taunt each other, sharing important moments of joy.

Overcooked is described as a game focused on teamwork and communication in quick action packed kitchen scenarios. It provides a high consistent visual and physical focus, but with a high communication need. Players must keep track of what kitchen tasks other players are currently doing, which orders are coming in, whilst constantly moving around obstacles to complete the orders. With more tasks than players, the game also requires players to communicate their ever-changing strategy to make sure they complete tasks promptly.

Active sending of communication is much more frequent within Overcooked, where much of the information is highly game dependent, has a short time sensitivity, and a high priority. This may lead to many bids for attention. These bids range through all three types of garner depending on the communication. Audio is used for very time sensitive information, such as when there are only a few seconds left before an item burns on the stove. In a game like Overcooked, players move closer together to allow for a stronger shared periphery to allow for visual bids. In our dataset, we observed moments of high dependence, and when visual garners failed on a particular receiver, players would tap each other on the shoulder, or when sat closer together, kick with their legs to get the attention of a specific player.

Throughout gameplay, there are few successful full conversations, and many discussions are left for longer

temporal windows, such as the end of a round or a paused game-state. In our dataset, we observed many altered modalities of communication. Players chose to point at locations in the game, such as a box of onions, to direct other players that more onions were needed, rather than signing the information directly across. We also observed some players use casual one-handedness more often in this game due to the higher physical focus required. In one instance, this caused confusion for one player sat partially behind a sender who couldn't understand the information being signed to them throughout, leading to more tension between players.

Critically, in Overcooked, the pause menu occludes most of the screen, restricting players' view of the in-game world. To combat this, in one instance of gameplay, during the first 30 seconds of a 3-minute round, one player put down their controller and took on a position closer to the screen, visible in others' periphery, to give orders and create a plan for that round. This caused a strong loss of gameplay but was decided to be a good trade-off allowing the other three players to work more effectively as a team. Similarly, players would run a 'trial run' of a new map the first time, trading gameplay and an entire attempt at the round for planning and discussion. Though Overcooked is a game of consistent mental and physical interaction, we noted multiple times where communications were altered, gameplay was traded off for communication, or was deferred until the end of the round.

5. DISCUSSION

We found that two interacting constraints; manual encumbrance from controllers, and competing visual attention between players and the screen shaped Deaf communication in gaming contexts. These physical and cognitive demands pushed communication into designated windows of lower game interactivity, and encouraged one-handed signs and gestures.

Recent work focusing on Deaf accessibility in games has started to show the various focused challenges faced by d/DHH gamers in relation to their communication needs (Luna et al. 2024). Our research builds upon this, showing the effects upon communication not only in the demographic of mixed-d/DHH communication but also in groups of exclusively SLUs. This revealed communication strategies that are less visible in mixed d/DHH groups. Our work also examines high intensity titles that use communication as a gameplay mechanic, alongside high-intensity titles that do not focus on communication in gameplay. We show that these adaptions to communication happen across gameplay types, but the form and style of interaction can change based on the tempo and demands of a given title. We found that communication in these Deaf groups is profoundly shaped by the visual and manual demands of the medium. Our work shows that games highly influence the way players could exchange information, underscoring the need for game systems to accommodate diverse communication practices. Communication frequently occurred pre-round, post-round, or during explicit pauses. When these windows are absent for too long, or are too brief, players resorted to faster gestures (eg, pointing briefly) that often carried less nuance and are more prone to misunderstandings.

Research Question 1 asked how *using a signed language affects the form of communication during co-located play*. Central to our findings is the need for participants to have a visual channel and a physical channel available for receiving and sending information respectively. Casual one-handed BSL, though a useful tactic, was found by some to be cumbersome and less comprehensible in the moment: players had to stop soon after to re-explain a concept because the receiver misunderstood the signs. The use of in-game systems, like the ones present in 'Fortnite' (2017), was beneficial as players didn't need to put down the controller, or look away from the screen. However, this method lacks nuance in its messages, with many stating it can be too vague such as 'look over there' without any additional context. The length of messages can also make it more difficult, as they need to quickly read longer messages to gain the context. Consistent iconography in these communication systems is more easily and quickly understood. Players would also use their characters actions in game to share game relevant information or help other players.

There was also a noted higher level of shared awareness around gameplay mechanics and teamwork. This was identified as players would often use just a bid to draw attention to an item rather than talking about what they need it for. For example; within hearing groups it may be more likely to hear "Bring the onions to the chopping board", our Deaf participants would just draw attention to the onions. This implies a heightened sense of shared awareness of the gamespace. As players were unable to discuss their plans throughout gameplay, we identified that players would discuss the game before starting a round, increasing that shared awareness in preparation.

Research Question 2 investigated *what communication strategies were used throughout various gameplay dynamics for Deaf players*. Our findings demonstrate that signed communication during gameplay is often asynchronous to gameplay and opportunistic, shaped by players' ongoing assessment of attentional availability. The timing and choreography of these social interactions are shaped by game mechanics. Pauses, countdowns, or readiness indicators created windows for communication exchange. Where these windows were absent or too short, communication is postponed or compressed into

a more brief, lower bandwidth form. Planning, strategising, and social exchange are displaced into the margins of play for Deaf SLUs, rather than being integrated into the flow of interaction, whereas hearing players can weave in social talk throughout their gameplay experience.

Shared communication windows enable players to share attention and communicate without a negative effect on gameplay. This was commonly seen in-between rounds in round based games, or where players are on a shared menu screen. Conversation was often condensed into these temporal windows, often exacerbated by limited time frames in these windows, which would allow for short bursts of communication. We found that Deaf players were often forced to make the decision to end a conversation early, or sacrifice readiness for the next round while within game-managed temporal windows. In games with indeterminate temporal windows, where players have control, conversation was easier, allowing for the planning of game strategy or social discussion before entering the next moment of gameplay.

Our findings found that visual focus was directed towards the game screen during moments of gameplay, shifting rapidly towards other participants when interaction reduced for a short period. At these boundary moments of gameplay, participants performed rapid visual scans, pivoting their gaze from the screen to their peers to check for mutual availability for conversation. When scanning was reciprocated, short multi-party exchanges occurred before the next active gameplay began. If participants did not reciprocate (either through remaining focused on the screen or showing lack of direct attention to that player), attention typically returned to gameplay with conversation being delayed until the next pause in gameplay. With eye-contact and focus being a necessary precursor to BSL conversations, scanning was a critical tactic for participants to maintain shared attention for communication. If other participants did not reciprocate that scanning and remained focused on the gamespace, the attention typically returned back to the screen.

When attention was required outside these times of visual scanning, participants attempted bids for attention. Various bids were used to garner attention, including audiological, visual and physical bids, dependent on factors like player positioning, the level of hearing of the intended recipient, and shared sightlines.

Our findings show that while participants attempted to configure gaming spaces according to deafspace principles, to maximise sightlines and mutual visibility, these principles were challenged by the presence of the dominant shared screen. In gaming contexts, the game screen becomes a primary focal point that competes with face-to-face or circular orientations, with co-players being important secondary focal points. Similarly to educational contexts, players often attempted to move to more semicircular seating patterns, attempting to balance access to the game and each other. These arrangements were not always possible and did not completely resolve the tension of visual access.

In some circumstances, such as in 2-player scenarios, they chose to sit very close for quicker attention. Whereas with larger amounts of players, they would often sit further apart to either allow all other players to remain in their periphery or to more easily balance sightlines. The dependency on visual accessibility meant that communication was contingent on maintaining visibility.

In instances where a player took on a role that required more communication e.g., they were more familiar with the game, but that player was in a less visible position, such as behind the player they aim to assist, they often shifted positions. In some cases, players moved to a position not unlike an interpreter, sat or stood next to the game screen. This allowed the other players an easier time to keep both main visual focal points at all times. However, it meant that the leading player had a stronger visual impedance to look back to the other players.

6. IMPLICATIONS FOR FUTURE DESIGN

It is important to remember that disability research can be effectively applied as universal design opportunities (Persson et al. 2015; Akoumianakis and Stephanidis 1989). Situational disabilities can affect anyone, and are especially applicable in this scenario (Wobbrock 2019). For example; where the players are in a loud environment where voice communication is impossible, or the players speak different languages. Implementing the MDCI in these environments would present similar results, and so can be used as a way to improve the user experience of general communication.

Garnering and affirming bids for attention
Deaf players are often disadvantaged when attempting to initiate communication because the resources required to start and notice a bid for attention are heavily committed to gameplay. To mitigate this, game developers should provide in-game mechanisms to bid for attention as this is already the predominant visual focus. One approach is to integrate attention indicators onto the UI that players can light up when the player wants to initiate conversation. This more easily allows players to bid for attention, and negotiate their visual load without removing focus from the game-state or visually scanning. These systems should also support bid affirmations, allowing players to indicate whether they are available or not to receive the communication. This makes delays in communication explicit to other players, reducing the chance that a bid goes entirely unanswered. This reframes delayed communication as

a negotiated outcome between players. By externalising attentional states, games can reduce the cognitive cost of managing communication under constraints for Deaf signers. An example of situation might look like this:

> [P1]: **Presses button changing status to 'want to send information' and selects P2 to notify**
> [P2]: **Able to notice in-game and sets status to 'unable to currently respond'**
> Both players continue interacting with the game-space.
> [P2]: **sets their status to 'Available to respond' and sends a visual notice to P1 to affirm they are ready to receive**
> Both players are able to now move their visual and physical resources to communicate.

Shared communication windows

Deaf players rely heavily on shared communication windows, often-times ones that are created and managed by the game itself. However, many games have rigid timing or automated transitions between moments of gameplay. Games often provide gameplay critical information during these times, assuming a continuous level of communication and interaction from players when the next gameplay starts. Our findings showed that players will sacrifice gameplay performance to preserve communication, such as intentionally forfeiting a round to continue their conversation. This was especially prevalent when games provided information that needed to be discussed. Important information, that would lead to longer discussion, such as planning the next round, should be provided to players in a temporal window which they control. Players can then create a plan before the gameplay begins, reducing their chance at forfeiting their first attempt to discuss.

To better support signed communication, games should avoid introducing temporal pressure during natural breaks in gameplay. Features such as the democratic 'Ready up' system', where all players must confirm readiness before the next round begins, allow these communication windows to be extended without penalising players. These considerations are particularly relevant for round-based games, but also apply to cooperative and asynchronous modes, where moments of low interaction can be intentionally preserved as communication opportunities.

Visually shared information

The inclusion of visual communication systems in games, such as 'pinging' or radial dial's, play an important part in supporting d/Deaf communication in gaming spaces. They provide a way of conveying game-related information through in-game channels to support shared situational awareness. These tools are particularly effective at conveying short, easily interpretable, direct statements (eg, 'Look here', "Go to this location"). In games where these are currently implemented show that they present benefits to the hearing population, in addition to being an accessibility tool. However, our participants described that for more complex communication, such as creating a detailed strategy, using these tools alone remains difficult. In-game visual communication tools can also be valuable during moments of downtime, such as menu navigation or pre-round planning. For example; allowing players to highlight menu options, or draw within shared spaces can support collaborative planning when gameplay pressure is lower. Game designers should be aware that these tools are beneficial but are not representative of the entire communication of d/Deaf players. While they support certain forms of information exchange, they do not capture the full range of communication, especially social communications.

BSL Gaming Signs

This study opens further conversation on how gaming can become more inclusive with Deaf communities. To our knowledge, the only AAA published game to include BSL as an included language is 'Forza Horizon 5' (Playground Games 2021). We found that many games did not have a pre-existing sign name, and so was finger-spelled. This lead to discussion amongst the participants about what sign they should use. For example with 'overcooked' (Team17 Digital, Ghost Town Games 2021): 'cooking' 'over' (a more literal Sign Supported English representation), or 'cooking' 'fire' (to represent the chaotic nature of the game with food setting on fire). Many in-game terms took on iconic signs where a similarly applicable lexical sign did not already exist. For example; many of the weapons within 'Fortnite' (Epic Games 2017) are nonsensical in nature. To better facilitate research, and inclusivity within gaming, a shared list of gaming signs in BSL should be collated for further use by Deaf gamers, interpreters, as well as developers and researchers, such as with the 'BSLGG' (2026).

7. CONCLUSION

We conducted a Co-Design and Sign-Comment observational study with 14 BSL Primary Language Users, focusing on the challenges d/DHH players face when communicating in a Co-located video game context. Our findings detail the impacts of manual encumbrance, and visual impedance on communication, shaping when, and how players garner attention, and sustain communication. We propose design implications aimed towards mitigating these barriers, supporting more accessible communication facilitation in video games. Future research should extend these findings by directly examining how game genres and mechanics are affected by these barriers, as well as in various contexts, such as through online multiplayer contexts.

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