# *Beam Me 'Round, Scotty! 2*: Reflections on Transforming Research Goals into Gameplay Mechanics

**John Harris**
University of Waterloo
Waterloo, Ontario, Canada
john.harris@uwaterloo.ca

**Mark Hancock**
University of Waterloo
Waterloo, Ontario, Canada
mark.hancock@uwaterloo.ca



## Abstract
We reflect on the design, implementation, and testing of the experimental testbed game *Beam Me 'Round, Scotty! 2* and the numerous design lessons learned in transitioning theoretical research questions about social presence and connectedness into concrete gameplay mechanics contrasting asymmetric and symmetric cooperative play. We discuss the unanticipated challenges that can emerge from seemingly unrelated design choices and the importance of grounding experimental conclusions and design recommendations in specific gameplay contexts.

## CCS Concepts
**•Human-centered computing** → **Empirical studies in HCI; •Applied computing** → *Computer games;*

## Author Keywords
Game design; Symmetric vs asymmetric play; Asymmetric games; Social presence; Games user research; Computer games; Player experience.

## Introduction
Digital games present powerful opportunities to share and learn with others in an imaginative social play context, but the creative freedom digital games afford their designers can be double-edged. Playing games with others has been shown to have many pro-social benefits, yet even in games

**Figure 1:** Scotty player's overhead view where they deploy abilities (hexagon tokens) using a multitouch tablet interface.

**Figure 2:** The Kirk player's third-person, over-the-should view where they traverse environmental hazards and defeat enemies using a gamepad interface. At this moment, Kirk can be seen melee striking an enemy Wasp which is stunned in place by one of Scotty's Shock Projectors (visible as lighting bolt particles). Meanwhile, Scotty is also attacking two other enemies using a teleporting bomb attack (top right, red warning glow.

we might expect to be hugely social experiences, such as the massively multiplayer online game *World of Warcraft* [8] with millions of players at the peak of its popularity, players can actually exhibit largely individualistic and egocentric behaviour [6]. As Hunicke et al.'s MDA framework discusses [14], game designers are free to add, subtract, or tune as many timings, visuals, interactions, and controls within their games in the pursuit of a desired aesthetic or social experience, but ultimately it can be extremely difficult to understand and predict how a game's design choices will play out dynamically in the presence of its players' creative inputs. How then might we more purposefully design for enriching social interaction in digital games?

Recent promising attempts to address this question have adopted a focus on asymmetric cooperative games [4, 7, 13], but it remains unclear what combination of elements within these games' designs are responsible for their uniquely engaging interdependent gameplay. By employing various forms of asymmetry as design tools (e.g., asymmetric abilities, information, feedback, rewards), these types of games are able to foster unique forms of interdependence between players such that social interaction and reciprocity is both advantageous and a natural part of the game.

In this paper, we reflect on the design rationale used in the development of our prototype game, *Beam Me 'Round, Scotty! 2*, and player experience study exploring how to enrich social play through asymmetry and interdependence. The goal of our player study was to explore the contrasts between symmetric and asymmetric cooperative play and we reflect on the process of transitioning from theory to experimental goals, to game design, and finally to concrete development. We discuss the complex web of interlocking trade-offs and unanticipated repercussions that emerged by engaging with this complete research cycle.

## Related Work

Significant effort has been put into analyzing common patterns of play and effective mechanics for promoting social play in existing games, with work by Zagal et al. [20] and Beznosyk et al. [1] highlighting distinctions between competitive, cooperative, and collaborative games and the degree of coupling between players' in-game interactions. Experimental games have explored how introducing asymmetries of information, perspective, ability, and communication can lessen frustration [19], encourage communication [7], build trust between strangers [5], and promote play between different demographics (e.g., young and elderly) [12].

Work by Harris et al. [13] attempts to bring useful design vocabulary and a more actionable structure to this still nascent study of interdependence in play via their proposed conceptual framework for the design, discussion, and analysis of asymmetric games, but it has yet to be thoroughly tested across disparate game genres and by a larger body of design practitioners.

It is at this intersection of player experience study and game design then that we situate our current work and focus on the pursuit of a better understanding of both how to design for asymmetry and interdependence in cooperative games and the effects they have on players' social experiences.

## Experimental Testbed Game

In order to explore this intersection of theory and practice, we developed a new prototype game for use as an experimental testbed for a player experience study. Simply titled *Beam Me 'Round, Scotty! 2* (*BMRS2*), this new game was based on the existing research prototype originally developed by Harris et al. [13] as part of an initial exploratory study of asymmetric cooperative play (*Beam Me 'Round, Scotty!*, or just *BMRS1*). By developing a complete proto-

type game, we were able to easily alter specific mechanical elements to create contrasting control/manipulation conditions while minimizing confounding influences such as changes in narrative or visual aesthetic. Further, by redesigning and expanding upon the concepts presented in the original research, our latest work was able to break new ground while remaining rooted in the design insights, player study results, and conceptual framework established previously and compare/contrast new changes to our prototype game's design as it grew and evolved.

*Beam Me 'Round, Scotty! 2* borrows it's essential premise from its predecessor: a two-player, co-located cooperative game in which one player takes on the role of marooned spaceship captain Kirk and another player takes on the supproting role of plucky starship engineer Scotty. In both *BMRS2* and *BMRS1*, Kirk players navigate their in-game avatar through a 3D world while engaging in combat with enemies and avoiding environmental hazards. Simultaneously, Scotty players are able to deploy a variety of special abilities such as healing Kirk, shocking/stunning enemies and objects, deploying bombs, creating physical shield walls, and teleporting Kirk short distances.

In *BMRS1*, both Kirk and Scotty players shared the same display screen. The game world was viewed from an isometric perspective with one player assuming the role of Kirk and the second player assuming the role of Scotty. Using a gamepad, Kirk players could move, aim, and shoot a medium-range blaster pistol but did not otherwise have any other abilities. Kirk's primary challenges were action and reflex oriented as they struggled to navigate the hostile environment. Scotty players used a mouse and radial menu interface to deploy their special abilities by pointing and clicking directly onto the 3D game world terrain. Scotty's abilities allowed them to heal Kirk, shock/stun enemies and objects, create force field barriers, lauch explosive torpedos at the surface, and teleport Kirk limited distances. Scotty's abilities required the expenditure of energy drawn from a limited pool of energy and, although Scotty's energy pool slowly regenerated over time, Scotty's primary challenge was managing this limited resource so as to be able to assist Kirk when necessary.

Harris et al.'s initial study [13] using *BMRS1* was exploratory in nature and revealed several interesting themes for future research: Were players' sense of connectedness and harmonious collaboration a result of the inherent asymmetries between the Kirk and Scotty roles or was this merely a result of the particular visual and narrative trappings of a starship crew who must cooperate in order to escape their stranding? Would a hypothetical "symmetric version" of the same game elicit similar perceptions of camaraderie and teamwork in its players? How might such a "symmetric" version of a deliberately asymmetric game be designed? And what more might we learn about the interaction of cooperative play, asymmetry, and interdependence by developing and testing this new game?

In addition to *BMRS1* being a unique and informative exploratory tool for the study of asymmetric cooperative play, player feedback led to numerous criticisms of that first game's design, such as the annoyance of having the 3D camera automatically follow Kirk (and by extension often interfering with Scotty's attempts to independently target objects in the world on the same screen) and how relatively uninteresting playing as Kirk was compared to Scotty.

*Beam Me 'Round, Scotty! 2*

*Beam Me 'Round, Scotty! 2* was designed and developed to address both these emergent research questions and improve upon the shortcomings discovered in *Beam Me 'Round, Scotty!*. Two of the most notable changes were

that each player now has their own dedicated display and that the Scotty interface was moved from a mouse to a multi-touch tablet. Kirk's perspective, no longer beholden to Scotty's hardware interface limitations, was shifted down, closer to the ground, in order to better target Kirk's action-oriented character archetype and, by borrowing design cues from modern action games such as the targeting system from *The Legend of Zelda* [9] and the combat animation timings from *Dark Souls* [10], siginificant effort went towards enriching the base Kirk gameplay mechanics.

Scotty's independent tablet interface now showed the game world from a top-down, satellite view, was no longer forced to follow Kirk, and was free to pan their view around the game world. Also, rather than targeting the use of abilities directly, Scotty players would now drag-and-drop virtual "command tokens"(left side of **??**) to deploying Scotty's special abilities. While initial playtests suggested that this token-based metaphor was simpler to understand and was more suitable for a touchscreen interface, it subtly changed most of Scotty's abilities in that Scotty players could no longer target individual objects. Most abilities became area-based instead. This was viewed as a net positive as it reduced the onus on Scotty to perform precise targeting tasks and being "close enough" was seen as better suiting the Scotty archetype laid out in *BMRS1*.

Having similarly been freed from the constraint of needing to share a single display with Scotty, Kirk's perspective into the 3D world was brought down from an elevated isometric view to an over-the-shoulder, third-person perspective (see Figure 2) and Kirk players were given manual control of their own camera via their gamepad's right joystick (similar to many modern 3D action games). In *BMRS2*, Kirk's blaster pistol was replaced with a handheld axe, shifting Kirk's primary focus from ranged shooting and accuracy to melee combat and dodging/positioning and Kirk can now make short distance dodge rolls and activate a forearm-mounted energy shield (much like a medieval knight) to block incoming attacks; all in pursuit of a more individually engaging, action-oriented Kirk experience.

*Enabling Symmetric Play*

While many of these new features were in part designed to address player feedback and improve the overall gameplay experience of *Beam Me 'Round, Scotty! 2*, their primary goal was to facilitate the study of *asymmetric* versus *symmetric* play. With the in-game Kirk and Scotty perspectives now decoupled, we could begin to approach the question of comparing and contrasting the traditional asymmetric play of *BMRS1* with novel symmetric gameplay modes in *BMRS2*. Whereas previously one player played as Kirk and one player played as Scotty, each with their associated asymmetries of ability, interface, and challenge, we wanted to be able to ask how the individual and social player experiences might change if both players played as the *same* characters but without changing the game world, narrative, or visual aesthetics.

While a theoretically straightforward task, the actual implementation of these new symmetric modes presented numerous design challenges that were not initially apparent without actually engaging in the full process of developing and studying the new prototype game. For example, at the heart of many asymmetric games is the interdependence between the asymmetric player roles and their inability to overcome obstacles without cooperation. Without an attendant Scotty character, how would a Kirk player traverse a chasm (an obstacle usually overcome with the help of Scotty's teleportation ability)?

Whereas we were theoretically concerned with design a new "Twin Kirk" experiment condition, once we began to

concretely develop our new prototype mechanics, we discovered a new design paradox we referred to as the "Lonely Kirk" vs "Super Kirk" problem: on one hand, this design problem could be resolved by altering the various challenges in the game to not require intervention from Scotty (Lonely Kirk). Chasms could be replaced with bridges, destructible boulder walls could be replaced with lock-and-key doors, etc. Alternatively, Kirk could be given direct control over Scotty's special abilities such that this hypothetical Super Kirk character could teleport themselves across chasms, deploy their own torpedoes, and heal themselves. Ultimately we chose to proceed with the Super Kirk design alternative as we felt it retained as many of the salient elements of the original asymmetric condition as possible. The narrative for this mode was also tweaked so that Super Kirk players were said to be requesting intervention from an A.I.-controlled "RoboScotty".

**Figure 3:** The equipment arrangement for the player study. Participants sat in front of a desk with easy access to two computer monitors, two handheld tablets, and two gamepad controllers. A camera above and behind the monitors (out of frame, top) recorded participants' verbal comments and non-verbal gestures.

The design of the "Twin Scotty" mode presented a similar design paradox: if both players in the dyad would be playing as separate Scotty characters, who/what would they be escorting across the planet's surface? Unlike the ambiguous choice between Lonely Kirks and Super Kirks, the concept of a "Lonely Scotty" archetype (with no Kirk character at all) was clearly less reasonable and was quickly disregarded. However, unique new design questions presented themselves. If there were to be non-player Kirk characters, how would they be controlled? How many non-player Kirks would there be: one shared by both Scotty players or one for each? Ultimately we chose to task each Scotty player with escorting their own relatively simple A.I.-controlled "RoboKirk" character; one RoboKirk per human player in order to maximize our experimental manipulation and further reduce player interdependence. While RoboKirk could be directed to walk to a location using a new Ping Location ability and be trusted to navigate around simple obstacles, RoboKirk would not attack enemies nor defend themselves from attacks. This was deemed an acceptable compromise based on the possible confound introduced by a more complex A.I. that would not easily be able to mimic the actions and behaviours of a live human Kirk player.

Three gameplay modes (1 asymmetric, 2 symmetric) were theorized, designed, developed, and refined for use in *BMRS2* that both successfully decoupled Scotty's interface from Kirk's and facilitated the study of contrasting symmetric versus asymmetric player experiences. The first, called "Split Mode", was the most similar to *BMRS1* with one player playing as Kirk and one player playing as Scotty in a cooperative team. In the second "Twin Kirks" mode, *both* players controlled a separate Super Kirk avatar simultaneously. Lastly, in "Twin Scotty" mode, both players controlled and escorted an A.I.-controlled "RoboKirk" non-player character using the regular Scotty interface.

## Player Study

Having successfully designed, developed, and pilot-tested our new prototype test game, we set out to explore our research questions by conducting a 2 (character: Kirk vs. Scotty) $\times$ 2 (symmetry: asymmetric vs. symmetric) within-subjects player experience study. We recruited 40 participants in 20 pairs with a median age of 21 from the local university population. Each pair was required to have a pre-existing social relationship (e.g., friends, classmates, family) but did not otherwise require any special qualifications (e.g., no prior game playing experience necessary). Participants were each compensated $15 for their time.

The study took place in a private room within the gaming lab at a public university. Participants were seated in rolling office chairs in front of a table upon which sat two monitors, two tablets, and two gamepads. A video camera positioned

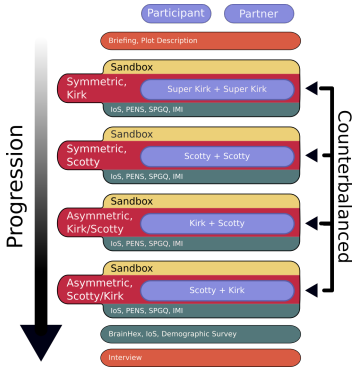


**Figure 4:** For the study, pairs of participants played through the same level 4 times using different configurations of character and symmetry each time. Each level was preceded by a tutorial/sandbox and followed by a battery of player experience survey questions.

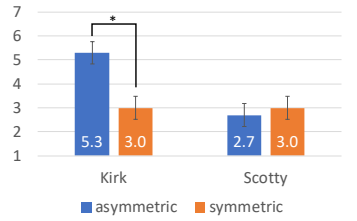


**Figure 5:** Interaction between character and symmetry on connectedness in the Inclusion of Other in the Self Scale. In asymmetric play, participants felt more connected to the other player, but only when playing as Kirk.

above the main displays recorded participants' verbal interactions, facial expressions, and non-verbal gestures. Participants' in-game actions were recorded via screen capture on each of the four display screens.

Over the course of each session, every participant would play through the entire prototype game four times, once for each condition (Figure 4). Each participant completed the game as Kirk twice, once with their partner as Kirk (Kirk, symmetric) and once with their partner as Scotty (Kirk, asymmetric), as well as Scotty twice, once with their partner as Scotty (Scotty, symmetric) and once with their partner as Kirk (Scotty, asymmetric). These four conditions were counterbalanced using a random 4×4 Latin square. Before each condition, participants were given a brief tutorial on how to use the new mechanics as well as five minutes to play and experiment with the game in a shared sandbox level.

Following each play session, each participant completed a series of self report surveys measuring connectedness with their partner (Inclusion of the Other in the Self Scale (IoS) [11]), social presence, empathy, negative feelings, and behavioural engagement (Social Presence in Gaming Questionnaire [15]), individual player experiences of competence, autonomy, immersion, and intuitive controls (Player Experience of Needs Satisfaction Survey [18]), and motivation via interest/enjoyment, effort/importance, and pressure/tension (Intrinsic Motivation Inventory (IMI) [17]).

Finally, each participant completed a short demographic survey and a semi-structured interview to conclude the experiment. Each session lasted approximately 90 minutes.

*Results of Self-Report Measures*

Generally, our experimental hypotheses proved accurate as statistical analysis of participants' self-report experience metrics showed that playing together in the asymmetric condition resulted in a significant positive effect on participant's perceptions of connectedness ($F_{1,36} = 4.5$, $p = .04$, $\eta_p^2 = .11$), engagement ($F_{1,36} = 6.0$, $p = .02$, $\eta_p^2 = .14$), immersion ($F_{1,36} = 7.7$, $p < .01$, $\eta_p^2 = .18$), and intuitive controls ($F_{1,36} = 5.8$, $p = .02$, $\eta_p^2 = .14$). Participants also reported feeling significantly more connected to their play partners when playing as Kirk than as Scotty ($F_{1,36} = 7.6$, $p < .01$, $\eta_p^2 = .17$). Post-hoc analysis of a significant interaction between character and symmetry on connectedness ($F_{1,36} = 7.6$, $p < .01$, $\eta_p^2 = .17$) revealed that for Kirk, participants rated themselves as feeling significantly more connected in the asymmetric condition (i.e., when their partner played as Scotty), than the symmetric condition, when playing with another Kirk, but when playing as Scotty this difference was not significant. Moreover, the ratings of connectedness for Scotty when playing with either Kirk or another Scotty were as low as when playing as Kirk with another Kirk (Figure 5).

This finding illustrates that, while asymmetric play *can* lead to feeling more connected to one's play partner, the role a player takes on can have a significant impact on these feelings. When playing asymmetrically in our study, it was only the Kirk player that felt more connected to their partner, not the Scotty player. This nuanced result is further explained by participant comments describing how, when playing as Kirk, Scotty's interventions felt "right there" beside them in the virtual world whereas, when playing as Scotty, Kirk felt remote through the tablet screen's distanced, overhead perspective. There were no significant main effects or interactions involving interest/enjoyment, effort, or pressure and thus we cannot draw conclusions about the effects of asymmetry and interdependence on these measures.

We also had participants rank the three game modes (two symmetric and the one asymmetric played in two ways)

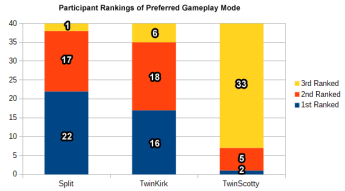


**Figure 6:** Participants were asked the three game modes in order of personal preference. More than half chose Split as their favourite followed closely by Twin Kirk. Twin Scotty was generally participant's least favourite mode.

in order of personal preference. Figure 6 shows that the asymmetric condition was most often ranked first (22⁄40 participants), and least often ranked last (1⁄40 participants).

## Design Reflection

While there are important quantitative insights to be gained about the influences of asymmetry and interdependence in social play from this player experience study of *BMRS2*, in this paper we instead focus on a qualitative reflection on the design of *BMRS2*, the experience of building a sequel (*BMRS2*) to an existing research prototype game, and the challenges of designing symmetric versions of an intrinsically asymmetric game. Based on thematic analysis of participants' captured video footage and interview responses, we also know that numerous seemingly innocuous design decisions made in the pursuit of our theoretical/experimental goals turned out to have significant and unanticipated repercussions on players' perceptions of interdependence and connectedness. And while we present this discussion with specific reference to *BMRS2*'s unique mechanics and play context, we expect similar difficulties would arise in the design and analysis of other asymmetric games. Thus, as future researchers pursue new theoretical understanding through comparative player experience studies like ours, we hope our experiences here might shed light on the intricate nuances and constraints introduced by practical design and concrete implementation of more complex experimental prototypes.

*Ability Range*

In *BMRS1*, Scotty's and Kirk's perspectives and understanding of the game world were tied together by their shared, single perspective. As a direct consequence, all of Scotty's special abilities were naturally deployed within relatively close proximity to Kirk. In *BMRS2* however, Scotty players could freely pan their view and investigate portions of the world distant from Kirk's avatar. On one hand, this proved beneficial by allowing some Scotty players to "scout ahead" and warn their partner about what enemies and obstacles awaited (a unique asymmetry of information). On the other hand, Scotty's powers could now operate beyond the area immediately nearby Kirk and many player pairs took advantage of this freedom with a form of preemptive "carpet bombing"; wherein Scotty players would torpedo any/all future enemies before Kirk even began to move. Super Kirk players would similarly exploit their newfound ability to target far in the distance (given the new over-the-should, third-person perspective) to clear out multiple distant enemies before approaching them.

While a perfectly valid play tactic, from a design perspective what began as a change to player cameras led to a undesirable "dominant strategy" [3] outcome, and the significant invalidation of Kirk's melee-centric gameplay challenges for those pairs who relied exclusively on this play style.

*Respawning, Level Transitions, & Collaboration*

In the "Split" condition (as in *BMRS1*), progress in the game was driven by the lone Kirk character either reaching a level transition or being defeated. However, in the "Twin Kirk" and "Twin Scotty" conditions (unique to *BMRS2*), where multiple Kirks/RoboKirks played simultaneously, we encountered a subtle but critical new design problem: When defeated, should a player respawn immediately without intervention/waiting for their partner? Conversely, should a successful player have to wait for their slower partner before they can both transition to the next level? In the extreme case (complete independence) two players could end up in entirely different sections of the game world and essentially be playing separate instances of a game while sitting beside each other. At the other extreme, players could end

up spending significant time waiting to re-synchronize with their partner.

In the interest of minimizing wait times (for both players and the overall experimental procedure), the design decision was made that defeated players would respawn automatically and *both* Kirks would be moved to the next level section as soon as *either* Kirk reached a transition. The repercussions of this design decision were both mixed and unanticipated. On the one hand, for player dyads with significantly mismatched skill/speed, this first-past-the-post mechanic allowed the more skilled player to effectively "carry" their partner through difficult challenges. In many cases, where a weaker player had failed a challenge repeatedly and grew frustrated, they would ask their partner "let's move on" and request that the stronger player trigger the next transition. Conversely, the ability for one player to race through and trigger a transition before the other player could attempt a section was instead frustrating. These players felt that their partners were thwarting their ability to meaningfully participate in the game, saying "In the Split condition, when you're both focused on one character, it feels like your decisions are more meaningful. Whereas in Twin Kirk and Twin Scotty, it didn't matter what I did because he could just do the level for me."

*Display Cognitive Overload*

In order to include two "Twin" conditions that were as similar to the original "Split" condition as possible, both the 3D views and overhead tablet views remained active even when not a direct part of a particular experimental condition. For example, during the "Twin Scotty" condition, when both players were otherwise occupied with their individual tablet interfaces, the two monitor perspectives automatically followed each player's respective RoboKirk character. Players did not have any control over this view but could still use it to indirectly observe the 3D world from Kirk's perspective. Based on interview feedback, participants described that they rarely used this "RoboKirk View".

Conversely, some participants did make use of the passive Scotty perspective while playing in the "Twin Kirk" condition (where each participant otherwise had their own 3D views of the game world to attend to). Many found this passive overview useful during a maze-like puzzle but otherwise described how it was difficult to switch their attention between their primary 3D view and the passive tablet display. (A criticism shared by the Nintendo Wii U gamepad's innovative but commercial unsuccessful gamepad display [2].) Many participants made the suggestion that a passive "mini-map" should be added to Kirk's display instead.

*Ability Tuning*

The majority of participants, when asked to discuss the relative utility of Scotty's various abilities, describe the teleportation ability as the most useful and the most overpowered. Many in-game challenges could be overcome simply by teleporting around them, so much so that many players expressed frustration at the tedium of having to manually walk when playing as Kirk. When asked to suggest improvements, many participants' suggested different means of limiting the effectiveness of the teleportation ability with comments such as, "While it's definitely unique and cool, it really just breaks the game."

*The Difficulty of Gauging Skill*

Throughout our study we found several pairs claiming to be looking for "glitches" and "speedrunning stats" and, rather than simply proceeding towards the final exit in a straightforward fashion, would try to get beyond the boundaries of the game world through creative use of Scotty's teleportation ability and Kirk's dodge action. Conversely, one pair of participants chose to deliberately constrain themselves by

*not* using the teleportation ability to navigate a particularly difficult hazard which, from our perspective, was specifically designed to *require* use of the teleporter. Much to our surprise, these boundary-pushing dyads almost always achieved their self-directed goals. Other pairs engaging in uniquely creative forms of play such as dueling with each other (once they discovered friendly fire was possible), racing to complete each level section first, obstructing each others' progress, and keeping score between themselves.

While we did not deliberately control for individual player skill in our study design, we were cognizant of the challenge of quantitatively measuring skill and that being *skillful* in a game does not always translate to obvious metrics such as speed, accuracy, or time to completion. These particularly imaginative and exploratory participants could be viewed as perhaps the *most* skilled class of participants despite their numerous (deliberate) deaths and slow progress.

*Preference and Suitability*
Not unexpectedly, we also observed several examples of individual players who were clearly better suited and/or more engaged by one character over the other. Participants who were anxious and uncomfortable when faced with the prospect of having to use the complex joystick and button combinations of Super Kirk's gamepad controls could, in contrast, exhibit distinct mastery and confidence when playing with Scotty's tablet interface instead. This highlights the distinction between pre-existing social circles (i.e., the friends participants chose to sign-up to the study with) and individual play preferences and aptitudes. In this regard, asymmetric games (and particularly games with asymmetric interfaces) present a unique opportunity to allow different types of players to play together in meaningful ways.

*Designed Interdependence vs. Emergent Cooperation*
Further refining Zagal's conception of collaborative games [20], we highlight a mechanical distinction between asymmetric games that *require* players to cooperate versus optionally *allow* cooperation.

Consider Super Kirk's healing ability: Because of the area of effect nature of this ability, there is nothing stopping one Super Kirk player from using their ability to heal their partner. In this way, the two Super Kirks can *choose* to cooperate but their symmetric abilities do not require that they do so. Compare this to an earlier iteration of the Super Kirk character not used in this study that saw Super Kirk's healing ability affect only the user themselves. As such, it was mechanically impossible for one Super Kirk to heal another.

By leaving the mechanical possibility for one Super Kirk to aid another but not require it, designers can leave the play open for "emergent cooperation" as opposed to "designed interdependence" between the two players, for example in the "Split" condition, where only Scotty can heal Kirk.

*Consequences for Level Design*
With the introduction of separate displays, Kirk's new perspective now had a distinct feature: by having Kirk looking *forward* there was now the possibility for in-game elements to appear *behind* Kirk, nearby but out of sight, and allowing enemies to ambush Kirk players.

Indeed, one of the original in-game encounters, described in the study of *BMRS1*, had one player lowering a drawbridge while the other fended off an ambushing swarm of wasps. In attempting to adapt this scenario to *BMRS2*, we quickly realized that, whereas previously the defending wasps appeared nearby but within sight of both Kirk and Scotty players, now Kirk players in *BMRS2* tended to find themselves directly facing the drawbridge control mecha-

nism, focused on trying to discern how to solve the puzzle and operate the bridge, when the wasps would appear *behind* them but off screen. Early playtesters found this moment exceedingly frustrating and unfair. Thus, what began as an attempt to improve the usability of Scotty's *ability targeting controls* (by separating Scotty's view from Kirk's) led to a frustrating failure in *level design* for Kirk.

As a further example, Kirk's new over-the-shoulder perspective also required careful consideration when attempting to transfer the use of Scotty's usual abilities to the new Super Kirk paradigm. Whereas previously small hills, rocks, or obstacles could be easily teleported around/over from the original isometric view, Kirk's over-the-shoulder perspective did not have the natural height to see past these obstacles. Walls blocked vision completely and so could not be easily teleported "through". Targeting distant objects also presented a new, non-linear challenge as the player's view of the terrain became increasingly oblique the farther away from Kirk it was viewed. Thus the difficulty of targeting Super Kirk's abilities now scaled with distance, whereas there was no proximity distinction for Scotty players.

## Conclusion

In this paper, we reflected on the process of redesigning an existing prototype game for use in a theoretical player experience study contrasting asymmetric and symmetric cooperative play. While we found evidence that asymmetric cooperation can have a positive effect on players' perceptions of connectedness, immersion, behaviour engagement, and even their understanding and comfort with the game's controls, we also uncovered many potentially important and unanticipated repercussions that can be encountered in the design and development of such games.

While many of our design reflections are specific to *Beam Me 'Round, Scotty! 2*, we describe them in detail to convey the necessary context and highlight the difficulty of generalizing lessons learned from the study of one game for use with other games. Despite significant similarities, there were major challenges transitioning numerous core mechanics and design elements from *BMRS1* into *BMRS2*. Consider instead then, the even more daunting prospect of generalizing player experience phenomena observed in much more disparate games such as *Tetris* [16] and *Dark Souls* [10].

With their inherently multifaceted nature, asymmetric games are uniquely positioned to bridge the gaps between individual player preferences and pre-existing social circles while providing inherently enriching social experiences but are also likely to be among the more difficult styles of games to study and analyze. The challenges we encountered here were only uncovered by engaging in the complete cycle of conceptualization, design, development, and testing and we hope our presented player study and design reflections will be useful stepping stones for future research attempting to bridge the gap between theory and practice.

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## REFERENCES

1. Anastasiia Beznosyk, Peter Quax, Wim Lamotte, and Karin Coninx. 2012. The effect of closely-coupled interaction on player experience in casual games.

*Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)* 7522 LNCS (2012), 243–255. DOI: http://dx.doi.org/10.1007/978-3-642-33542-6_21

2. Mark Brown. 2016. Game Maker's Toolkit: A Deep Dive into Star Fox Zero's Controls. (23 May 2016). https://youtu.be/m544qfVMIPs
3. Keith Burgun. 2011. Understanding Balancing in Video Games. (8 June 2011). https://www.gamasutra.com/view/feature/134768/understanding_balance_in_video_.php
4. Ansgar E Depping and Regan L Mandryk. 2017. Cooperation and Interdependence: How Multiplayer Games Increase Social Closeness. In *Proceedings of the Annual Symposium on Computer-Human Interaction in Play*. ACM, 449–461.
5. Ansgar E Depping, Regan L Mandryk, Colby Johanson, Jason T Bowey, and Shelby C Thomson. 2016. Trust me: social games are better than social icebreakers at building trust. In *Proceedings of the 2016 Annual Symposium on Computer-Human Interaction in Play*. ACM, 116–129.
6. Nicolas Ducheneaut, Nicholas Yee, Eric Nickell, and Robert J Moore. 2006. âĂIJ Alone Together ?âĂİ Exploring the Social Dynamics of Massively Multiplayer Online Games. *Chi 2006* March (2006), 407–416. DOI: http://dx.doi.org/10.1145/1124772.1124834
7. Katharina Emmerich and Maic Masuch. 2017. The Impact of Game Patterns on Player Experience and Social Interaction in Co-Located Multiplayer Games. In *Proceedings of the Annual Symposium on Computer-Human Interaction in Play*. ACM, 411–422.
8. Blizzard Entertainment. 2004. *World of Warcraft*. Game [PC]. (23 November 2004).
9. Nintendo EPD. 2017. *The Legend of Zelda: Breath of the Wild*. Game [Wii U]. (3 March 2017). Nintendo, Kyoto, Japan. Last played March 2018.
10. FromSoftware. 2011. *Dark Souls*. Game [PlayStation3]. (22 September 2011). Tokyo, Japan. Last played March 2018.
11. Simon Gachter, Chris Starmer, and Fabio Tufano. 2015. Measuring the closeness of relationships: A comprehensive evaluation of the 'inclusion of the other in the self' scale. *PLoS ONE* 10, 6 (2015), e0129478. DOI: http://dx.doi.org/10.1371/journal.pone.0129478
12. Kathrin Gerling, Regan L Mandryk, and others. 2014. Designing video games for older adults and caregivers. In *Proceedings of the International Academic Conference on Meaningful Play*.
13. John Harris, Mark Hancock, and Stacey D Scott. 2016. Leveraging Asymmetries in Multiplayer Games: Investigating Design Elements of Interdependent Play. *Proceedings of the 2016 Annual Symposium on Computer-Human Interaction in Play - CHI PLAY '16* (2016), 350–361. DOI: http://dx.doi.org/10.1145/2967934.2968113
14. Robin Hunicke, Marc LeBlanc, and Robert Zubek. 2004. MDA: A Formal Approach to Game Design and Game Research. *Workshop on Challenges in Game AI* (2004), 1–4. DOI:http://dx.doi.org/10.1.1.79.4561

15. Yvonne a W De Kort, Karolien Poels, and Wijnand Ijsselsteijn. 2007. Digital Games as Social Presence Technology : Development of the Social Presence in Gaming Questionnaire ( SPGQ ). *Digital Games as Social Presence Technology _ PRESENCE 2007* (2007), 1–9. DOI: http://dx.doi.org/10.1177/1046878111422121

16. Alexey Pajitnov. 1984. *Tetris*. Game [PC]. (6 June 1984).

17. Richard M Ryan, Valerie Mims, and Richard Koestner. 1983. Relation of reward contingency and interpersonal context to intrinsic motivation: A review and test using cognitive evaluation theory. *Journal of personality and Social Psychology* 45, 4 (1983), 736.

18. Richard M Ryan, C Scott Rigby, and Andrew Przybylski. 2006. The motivational pull of video games: A self-determination theory approach. *Motivation and emotion* 30, 4 (2006), 344–360.

19. Pejman Sajjadi, Edgar Omar Cebolledo Gutierrez, Sandra Trullemans, and Olga De Troyer. 2014. Maze Commander: A Collaborative Asynchronous Game Using the Oculus Rift & the Sifteo Cubes. *Proceedings of the First ACM SIGCHI Annual Symposium on Computer-human Interaction in Play* (2014), 227–236. DOI:http://dx.doi.org/10.1145/2658537.2658690

20. José P Zagal, Jochen Rick, and Idris Hsi. 2006. Collaborative games: Lessons learned from board games. *Simulation & Gaming* 37, 1 (2006), 24–40.