Using the Evolution of the Instagram User Interface as a Case Study into the Ethical Implications of Infinite Scroll Interface Design

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On my honor as a University Student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments

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Introduction

While in COVID-19 quarantine back in September of 2020, imprisoned within the canvas walls of a tent in my parent's backyard, I set a one-day, single-app screen time record on the social media platform of Tik Tok: 14 hours. The experience vividly highlighted an addiction that had been growing for the entire year prior. Finally recognizing I was completely unable to self-regulate my use of the app, I was quick to delete it. Unfortunately, where one app fell, another has quickly taken its place. Still, I continue to spend hours a day scrolling through Instagram and other social media that implement the same dynamic user interface of infinite scroll, a design strategy that has plagued my academic success, emotional wellbeing, and personal fulfillment ever increasingly. My experience is nothing unique; a recent meta-analysis of studies across 32 nations looking at social media addiction rates, all using the Bergen Social Media Addiction Scale found an average prevalence rate of 13%; a number that quickly increased to 25% when more inclusive addiction classification cutoffs were used (Chang et al. 2021, p. 5). Through statistics like these it is obvious that the omnipresence of endless scrolling applications in social media platforms has now ushered in an era of media consumption unlike anything before.

Infinite scroll (IS) is a front-end interface development technique that creates seemingly endless content. Used in all the largest social media applications, it has skyrocketed in popularity due to its unprecedented user retention power. The software replaces conventional pagination with the dynamic loading of new content that is triggered and preloaded as the user scrolls, making the page appear endless or 'infinite'. The interface draws power especially from the machine learning algorithms that run in the background, creating hyper-accurate user models. By learning user characteristics, habits, and interests, these social media applications are able to create incredibly tailored and immersive browsing experiences. Ethical issues arise with the

monetary incentive these companies have: in keeping their users active for as long as possible, they can present more and better-tailored advertisements (McSpedden-Brown, 2022, p. 5). This commodification of human immersion in media goes inherently against the best interest of the consumers. In this way we see the "users" become the "used". Throughout this paper I examine the ethical implications of the Infinite Scrolling (IS) interface, arguing that its intentionally addictive design not only commodifies user attention but also significantly undermines user well-being. By integrating historical user interface evolutions with current behavioral data, this paper highlights how IS interfaces serve corporate interest at the expense of user health and autonomy.

Understanding Infinite Scroll and its role in Social Media Use

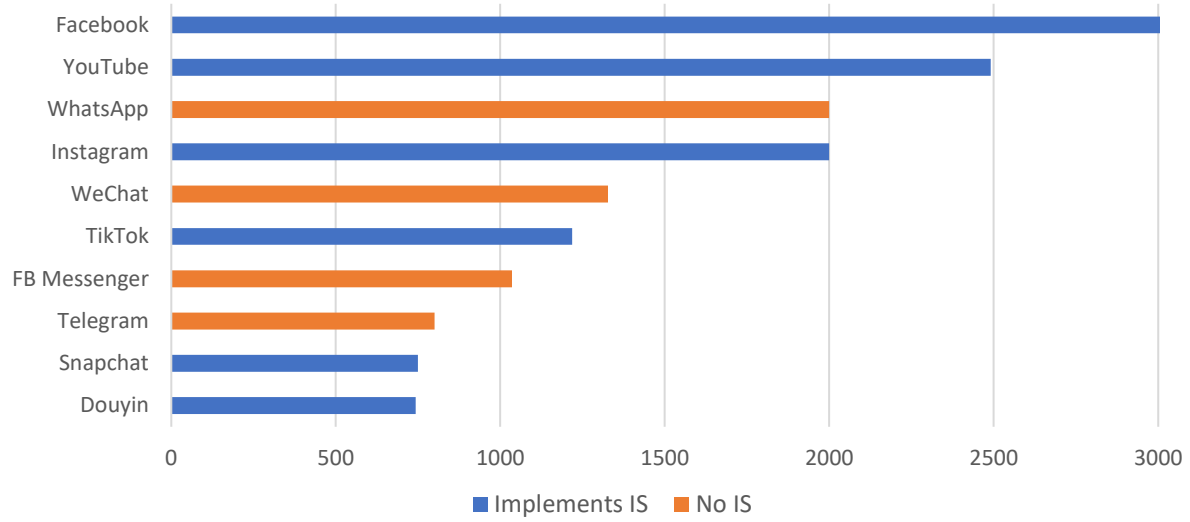
Social media rates are now at an all-time high. 3.96 billion people around the world use at least one social media network. The global average for daily social media use is two hours and twenty-four minutes. (Dean B., 2023). 79% of smartphone users check their phone as soon as they wake up (Eyal & Hoover, 2014). The proportion of young people using social media for more than 4 hours a day has increased from 19.1% in 2016 to 65.6% in 2019, and the proportion using more than 6 hours a day has grown from 9.8% to 42% at the same time (Giraldo-Luque et al., 2020, p. 6). Additionally, social media user numbers have averaged a yearly growth rate of 12.5% since 2015 (Dean B. 2023). The world is becoming increasingly attached to social media and IS applications have played a huge role in this.

IS was pioneered by software engineer Aza Raskin in 2006 while working at a small user-interface company called Humanized. It was later improved upon by and developed into a JavaScript plugin by Paul Irish. The feature was initially designed to address pagination issues:

by providing a seamless and uninterrupted browsing experience, user experience could be greatly enhanced. Unfortunately, IS more than accomplished its developer's goal.

Figure 1. Monthly Active User Data for the Top Social Media Applications (in millions)

Figure 1 is taken from Statista, 2024, and shows the most popular social networks worldwide as of April 2024, ranked by the number of monthly active users.



Looking at Figure 1, each of the top social media applications—excluding those designed solely for direct messaging—all implement Infinite Scrolling capabilities. As obvious in Figure 1, IS has now become ubiquitous with almost all modern social media due to its unprecedented power to immerse and entertain users.

When looking at social media from a consumer perspective, it is helpful to break utilization into two main cases: active and passive. The first, 'active', involves the intentional use of social media to connect with other individuals in purposeful forms of communication such as messaging, commenting, or posting content. Looking again at Figure 1, applications like WhatsApp, WeChat, FB Messenger, and Telegram—all designed specifically for direct messaging—are great examples of 'active' use social media. When thinking of the benefits of social media, we often think foremost of this ability to connect with individuals anywhere at any

time. Contrarily, ‘passive’ use refers to the unintentional, mindless use of social media that often occurs simply to pass time. In an article titled “Addiction by Design”, authors Mujica, Crowell, Villano and Uddin highlight this especially well:

> It is becoming increasingly clear that social media platforms are designed intentionally to maximize their addictive potential. Addiction by design on the part of social media companies is fueled by their ‘attention economy’ business model in which revenue is earned from advertisements shown to platform users. In this model, the more advertisements platform users view, the more revenue those ads generate for the social media company. Under such a ‘pay per view’ economy, social media companies are economically motivated to addict their users such that they will stay on the platforms longer and come back as often as possible. (Mujica et. Al, 2022, p. 3)

Thus, many social media companies have moved from designing platforms around connecting us in ‘active’ ways, to instead encouraging and inciting as much passive use as possible.

As advertisements continue to be the main source of revenue for most social media companies, this fiscal motivation corporations have in inciting and sustaining passive user use directly opposes the best interest of the users. Such design systems can be labeled as “dark commercial patterns” (Farthing, Anderson, Dawkins, 2023, p. 7). The OECD (Organisation for Economic Co-operation and Development) defines dark commercial patterns as “business practices employing elements of digital choice architecture, in particular in online user interfaces, that subvert or impair consumer autonomy, decision-making or choice. They often deceive, coerce, or manipulate consumers and are likely to cause direct or indirect consumer detriment in various ways, though it may be difficult or impossible to measure such detriment in many instances" (McSpedden-Brown, 2022). In IS applications, these dark commercial patterns

largely manifest in the application's passive-use retention capabilities. This is the disrupting condition: not just that social media addiction and usage rates are at an all time high, but rather that these issues are a direct result of the dark commercial patterns and predatory attention economy—both encouraged by IS—through which social media companies now operate.

Having established that social media use is at an all-time high, that comes with significant consequences. The ACM (Association for Computing Machinery) on Human-Computer Interaction conducted a study in 2018 and reported that "nearly 90% of parents and teens use language of addiction/obsession, distancing/defensiveness, and/or concern/shame when responding to the open-ended survey and interview questions about their relationship with their phones" (Lanette et al., 2018, p. 29). Additionally, a meta-analysis of eight studies that looked at the relationship between problematic social media usage and depression found a "consistently significant correlation" between the two (Sohn et al. 2019). Finally, "Andreassen identified a number of deleterious effects of social media addiction ranging from heightened interpersonal conflicts and disturbed sleep to reduced life satisfaction and impaired study or work performance" (Andreassen, 2015) (Mujica et al. 2022). Looking at the previous evidence altogether, we can see that there is a significant relationship between the over-use of social media and personal well-being.

While the over-use of social media comes with countless adverse effects, it is also important to note that not all media use has similar outcomes. A recent study done by the Institute for Media Informatics at Ulm University in Germany showed that, for extended social media sessions (10+ minutes), over 90% of user-sessions were reported to have been made up of mostly infinite scrolling. The same study also went on to show that IS media sessions were on average the longest. As there can only be so much inter-personal content on social media, it

makes sense that “the longer the session gets, the more likely it is that IS becomes a part of it” (Rixen et al., 2023, p. 228:17). More generalized, these statistics show that most long-session social media use involves passive infinite scrolling.

In addition to showing the prevalence of passive IS, the study investigated the emotional impacts of different types of social media use. Valence, within the context of the study, was defined as user emotional fulfillment/satisfaction. The authors go on to say that, “overall, participants reported higher levels of Valence after sessions that mainly consisted of Posting or Watching Stories compared to those that mainly centered around Infinite Scrolling.” (Rixen et al., 2023, p. 228:14). Another study done in 2021 backs this up, saying: “further study found that IS in general lead to the highest amounts of retrospective regret” (Cho et al., 2021, p. 456:13). Thus, it is evident that IS, while being responsible for the majority of long-sessioned use, is also the least user-fulfilling when compared with social media design techniques. Finally, considering the significant correlation between the over-use of social media and personal wellbeing discussed earlier, and given that IS encourages over-use and is less user-fulfilling than other social media design techniques, we can say that there is a significant negative correlation between IS and the user’s well-being.

In the following sections, I will first use Martin and Schinzinger’s lens of “Engineering as Social Experimentation” to illuminate the negative ethical implications of IS from an engineering perspective, and will later analyze the evolution of the Instagram UI to prove the malevolence in the app’s current design.

Ethical Contradictions within Infinite Scroll Interface Design

Within a research approach it is vital to have a foundational source—a primary template that serves to guide and give structure to future research, findings, and analysis. Here I use Martin & Schinzinger's "Engineering as Social Experimentation" as a framework through which to analyze the ethical design implications and user-effects that IS has. In the article, Martin & Schinzinger focus on the conscious, intentional ethical dimensions an engineer must adopt in order to create socially positive products. A secondary focus of the article is the ways in which modern engineering corporate structure discourages this. The source is particularly useful as Infinite Scroll is purposefully addictive in its design, and Martin & Schinzinger's article—which focuses largely on the moral intentionality in engineering—gives structure to analyze both the user interface and the software engineers who are responsible for deploying it from an ethical perspective.

In Chapter 3 of their book titled *Ethics in Engineering*, Martin & Schinzinger propose that all large-scale engineering be thought of as a social experiment. We often think of an engineering project as an innovative design, construction, and solution to a problem of varying societal impact. Once its production is complete, we think of its engineering as being over. Martin & Schinzinger stress that engineering "also extends to the stage of client use" (Martin et al., 1989, p. 82). Given that having human beings as subjects brings an uncontrollable nature to any project, they highlight that all engineering is, by definition, "generally uncertain". Therefore Martin & Schinzinger argue it is useful to think of engineering as a "natural experiment" (Martin et al., 1989, p. 82). They argue that an ethical engineer needs four main virtues. First, a commitment to the safety of their human subjects. Second, a constant effort to monitor their experiment throughout its journey. Third, autonomous and contextual, knowledgeable personal

involvement in their project. Fourth and finally, accepting accountability for the project's results, whatever they may be. The authors argue that only through the adoption of these four values can an engineer hope to be ethically just in their design.

Especially relevant to the concept of Infinite Scrolling is Martin & Schinzinger's second value: the concept of monitoring. The authors define monitoring as "[making] periodic observations and tests in order to check for both successful performance and unintended side effects" (Martin et al., 1989, p. 84). This concept is incredibly useful looking towards the role subject-monitoring has played with addictiveness and over-use in social media applications that implement IS.

As discussed briefly in the introduction, Infinite scroll applications do a fantastic job of tracking user behavior and interactions to understand engagement patterns. Already in 2013, computational scientists analyzed the Facebook likes of 54 thousand volunteers, and proved that, with 85%, 95%, 93%, and 88% accuracy respectively, they were able to predict an individual's political leanings, race, gender, and sexual orientation (Kosinski et al. 2013, p. 5803). Over a decade later, IS has enabled the tracking of an unimaginable amount of hyper-specific user interaction data. Social media companies now use "thousands of ranking signals. Everything from the speed of a user's internet connection to whether they prefer to engage by liking or commenting" (Mujica et al., p. 15, 2022). This has allowed IS a special and unparalleled ability in aiding the creation and tailoring of these user models. In addition to learning user interests, insecurities, hopes, vices, and more from tracking and analyzing engagement patterns, social media companies, through browser cookies and the data-market, are able to learn frighteningly more.

> Once users create an Internet account with a so-called "Big-Tech" company (e.g., Google, Amazon, Facebook), they establish digital footprints containing a fair amount of information about themselves and their online behaviors. This footprint can include personal information such as name, gender, age, physical address, driver's license, and even social security number, depending on which Big Tech accounts they have created and what info the account creation process requires. In addition, by virtue of going online with a browser or an app, information is available about a user's history of web browsing, sites visited, current location provided by the IP address and/or GPS sensor on their device. Purchase history, email and message history, and information provided about personal preferences or attitudes provided through online surveys also may be available. (Mujica et al., p. 13, 2022)

Thus, social media companies have become alarmingly good at monitoring, knowing, and predicting their users. Complications arise in that —returning above to Martin & Schinzinger's values of an ethical engineer—while these social media apps abide closely by value number two, they use the second ethical value to directly oppose the first.

Figure 1. How Modern Social Media Corporations and their Employees stack up against Martin & Schinzinger's Values for Engineering as a Social Experimentation.

Taken from Martin et al. p. 89, the left column displays the four virtues Martin & Schinzinger argue are vital to ethical engineering practices. In the middle and right columns, I describe how modern social media companies and their employees measure up to these values respectively.

Martin & Schinzinger's Values for Engineering as a Social Experiment (p. 89)	**Social Media Corporations that Implement Infinite Scroll with User-Algorithms**	**Software Engineers within SM Corporations**
1) "A primary obligation to protect the safety of human subjects and respect their right of consent"	SM corporations use user data to optimize and increase user usage, and then monetize it by selling user data to advertisers.	In large corporations the affective and physical distance between oneself and a product creates an environment that promotes ethical apathy

2) “A constant awareness of the experimental nature of any project, imaginative forecasting of its possible side effects, and a reasonable effort to monitor them”	With the aggregation and analyzation of massive amounts of user data, SM corporations can create highly accurate user models	Engineers in SM corporations work on algorithms that track users, instead of tracking users directly, which creates affective distance and apathy between the engineers and their subjects
3) “Autonomous, personal involvement in all steps of a project”	SM corporations operate largely autonomously, with very little overhead regulation from governing entities	With huge managerial oversight structures present in SM corporations, ethical autonomy is suppressed for fear of dismissal
4) “Accepting accountability for the results of a project”	SM corporations currently do not care about the potential adverse effects of their platforms, as caring would subvert their data-driven revenue models	As with value 1, In large corporations the affective and physical distance between oneself and a product creates an environment that discourages accountability and culpability

Great monitoring empowers the applications to better themselves, but unfortunately it is exploited in two distinct ways. First, companies aim to increase user usage by optimizing content. Second, user views and data is sold away, as advertisers are willing to pay much more for tailored audience segments. Having detailed personal data available to the highest bidder is not in the best interest of the user, nor is increasing the usage of an already intentionally addictive and unfulfilling application. Thus, IS data practices actively defy Martin & Schinzinger’s first value.

Having looked at values one and two, we now turn to three and four. In Martin & Schinzinger these are closely related. The authors introduce the concept of an engineer’s autonomous personal involvement and level of accountability for a project they are working on, and the role authority and large corporation plays in discouraging those. They write, “it is a comfortable illusion to think that in working for an employer, … one is no longer morally and

personally identified with one's actions" (Martin et al. p. 92). In large corporations it is easy to feel very distanced, both affectively and physically, from the product you are working on. "The contemporary working conditions of engineers tend to narrow moral vision", Martin and Schinzinger write (Martin et al. p. 90). This concept of distance felt by corporate engineers, combined with the often-present managerial attitude that "near-term profitability is more important than consistent quality and long-term retention of satisfied customers" (Martin et al. p. 93), has helped aid the creation of unethical products such as infinite scroll and the algorithms that hide behind it. Looking at Figure 1, using Martin & Schinzinger's values it is easy to see the moral shortcomings that modern corporate structure has created.

Martin & Schinzinger's chapter titled "Engineering as a Social Experiment" is particularly valuable as, as was done in Figure 1, its rubric and values can be applied both to engineering corporations and the engineers within as individuals, thereby illuminating the inner dynamics of modern corporate structure that allow for engineering products such as infinite scroll to take place.

Evaluating Infinite Scroll within Instagram

To look at the ethical dimensions of the design of infinite scroll as an interface, I will be using Instagram as a case study. I will show how through Instagram's interface evolution the design has grown less ethical over time. I will additionally be using Martin & Schinzinger's values of engineering as social experimentation as the framework from which to analyze the application.

To recap, social media companies accomplish their IS passive user retention through two specific strategies. First, they create a visually pleasing interface design that immerses the user into the application for as long as possible. Second, by collecting and analyzing user data, the applications can tailor content on an individual basis, making the application even more immersive and entertaining.

Looking at the first strategy, Instagram's transition to IS is most obvious in the evolvement of the application interface. The app used to tell the user "You're all caught up", after all new content had been viewed in one's personal home feed. By removing this and adding suggested posts to make the feed infinite (IS), Instagram removed the most natural reminder and stopping point for a consumer's use session. This emphasis on IS is again seen in more recent features Instagram has employed to shepherd its users towards IS interfaces. The five icons on the Instagram bottom navigation bar used to be as follows: Home feed, Search, Posting, Activity, and Profile—none of which implemented IS interfaces. Now, home feed implements IS, Search has become Search & Explore (IS), and Activity has been replaced with Reels (IS). Contrarily, Activity, one of the most 'active use' features, has been moved to small icons in the upper right-hand corner with Direct Messaging in one of the five home screens. All these interface design features shepherd the user toward IS interfaces, proving Instagram's increasing use and emphasis on IS.

The authors of a study done in September 2023 titled, "The Loop and Reasons to Break It", break down the effects of this in two mains ways:

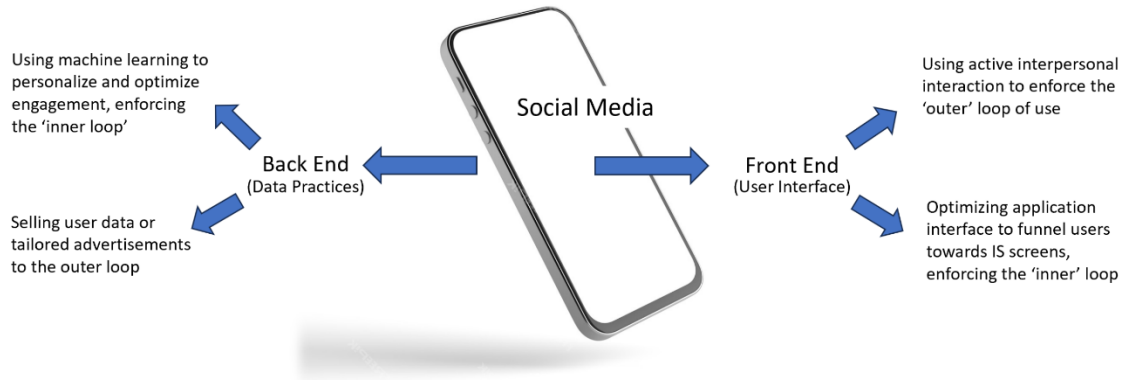
> We argue that IS does not facilitate one but two inter-weaved loops, which can entrap the user. First, IS features can facilitate habitual, repeated use, creating an outer loop of repeatedly opening SM to utilize IS features. Second, the same IS features can then escalate

> these sessions catching the user in an intra-sessional, inner loop leading to elongated regretful use. (Rixen et al, 2023, p. 228:3)

Within the article the 'outer' loop is defined as the number of pickups: the frequency with which the user opens the IS applications. Alternatively, the 'inner' loop simply refers to the length of each of those IS sessions. It is through understanding these two loops, and their relation to active vs. passive use, that we can better understand the addictiveness of IS.

Figure 3. Frontend and Backend Design Practices and their effect on the 'Inner' & 'Outer' Engagement Loops

This figure relates both the back-end and front-end of Instagram to the inner and outer engagement loops



Specifically, Instagram utilizes the outer-loop of inter-personal active use to trigger passive, inner-loop, elongated use. Notifications are paramount in the outer loop, as they act as the trigger, the reminder to the user that the app is incessantly there. When the user loads the app and starts to look for whatever inter-personal interaction they were notified about, they are bombarded with IS links and interfaces that are designed to quickly immerse them into elongated use. Looking back towards Instagram's interface layout, when a user gets a direct message, they first must navigate through the IS interface of the home feed before they can access their message. Back in the home feed, Instagram now quickly displays a row of suggested reels, guiding the user from one IS interface to an even more immersive second: an IS interface

involving vertical videos that, taking up your entire screen, enrapture the user even more than in the first IS environment. Even during the duration of writing this thesis, the Instagram Home Feed UI has changed from displaying one small row of suggested reels, to a double row without margins. This new UI feature takes up most of the screen when scrolling past. These changes with suggested reels, in combination with the changes to the menu navigation bar, all directly prove that Instagram is trying to promote IS interfaces that encourage the passive, inner use loop. Encouraging over-use and addiction via encouraging the passive, inner use loop is clearly not in the best interest of the user. Thus, through the app's changes to its UI, Instagram is operating directly against Martin & Schinzinger's first virtue for ethical engineering: a primary obligation to protect the safety of human subjects.

Secondarily, Instagram now has incredibly accurate user models, and tracks closely the topics that users are interested in. It is obvious when using the app that the more one engages with a topic or a type of content, the more that same category of content is likely to reappear frequently. This is an example of Instagram's backend algorithms tailoring content to promote relatability and engagement. While having personalized content on a user-to-user basis might seem like a positive, Instagram's motivation behind doing so is what makes the feature dangerous. Going back to before, Instagram uses monitoring to promote dark commercial patterns, creating an ever-increasingly engaging and addictive app that is hard to remove oneself from. Additionally, Instagram uses monitoring to target adds to susceptible demographics. In these two ways, the backend of Instagram uses Martin & Schinzinger's second ethical virtue of monitoring to again oppose the first: the well-being and safety of its users.

Finally, when looking at ethical engineering virtues three and four, the results are disappointing again. For the third, "autonomous personal involvement in all stages of a project",

Instagram is largely unregulated in the United States in how it aggregates, stores, and sells user data. In terms of the fourth, “accepting accountability for the results of a project”, Instagram will never voluntarily take accountability for the negative impact their applications increasingly have as it would directly oppose their profit model. Thus, Instagram’s evolution—both in backend and frontend—is emblematic of a very scary and unapologetic trend in social media companies: addict users to increase revenue.

Conclusion

In summation, the pervasive implementation of Infinite Scrolling in social media interfaces emerges not merely as a design choice but as a profound ethical concern. In this paper I have demonstrated a clear correlation between IS usage and detrimental effects on users, substantiating the claim through both theoretical frameworks and empirical evidence. Given the manipulative nature of IS and its alignment with profit-driven dark commercial patterns at the cost of the user’s well-being, there must be an urgent call for regulatory measures. Such interventions must aim to stop the exploitative practices currently used by social media companies, ensuring that social media serves to enhance our lives, not diminish them. More broadly, we as consumers must ensure we stay the users of technology, not the ones being used.

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