

Article

A Case Study on Applications of the Hook Model in Software Products

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Abstract: The Hook model is used in digital products to engage and retain users through the mechanism of habit formation. This paper explores the use of Hook model techniques in two mobile applications, one being a popular taxi service (Uber taxi) and the other a social network (Instagram). The goal of this paper is to explore the Hook cycle patterns in the two products, and to identify commonalities and differences in how they are applied. Our results suggest that Hook cycle patterns appear with similar frequency; however, Instagram includes more internal *Trigger* calls. Uber uses fewer triggers to encourage usage, most probably because users already have a specific need for the application. For the same reason, Uber has less opportunity to fail in the reward delivery, while Instagram can use the failure (in providing a reward) as another trigger if the usage habit is already established. In addition, we introduce two types of Hook cycle patterns: internal (within a single use case) and external (transition between use cases). The insights obtained through the case studies serve as a practical reference for developing engaging and retention-focused applications.

Keywords: human–computer interaction; persuasive technology; habit-forming products; hook model; Instagram; Uber



Citation: Lukyanchikova, E.; Askarbekuly, N.; Aslam, H.; Mazzara, M. A Case Study on Applications of the Hook Model in Software Products. *Software* **2023**, *2*, 292–309. <https://doi.org/10.3390/software2020014>

Academic Editor: Francisco José García-Peñalvo

Received: 8 January 2023

Revised: 3 April 2023

Accepted: 10 April 2023

Published: 16 May 2023



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1. Introduction

For many software products, user retention and engagement are the primary metrics of product success [1], as they allow for growth and in the ideal case can result in conversion to sales. One way to increase engagement and retention is to habituate the user to the product. The Hook model, authored by Nir Eyal in 2013 [2], suggests a set of techniques for habit formation in digital products. The main idea behind it is to make users go through a set of interactions with the product, called the Hook cycle, starting from the *Trigger*, followed by *Action* and *Reward*, into the final step called *Investment*. After going through the cycle a number of times, the user is expected to create an association that the product is the solution for a certain type of problem or discomfort.

In this paper, we examine the use of Hook model techniques in two applications with varying business models. One is a taxi-ordering application (Uber taxi) that aims to satisfy the customer through an easy and quick service. The other is a social network (Instagram), which mainly earns from advertising, and thus the more time users spend on the app, the better.

Our hypothesis is that the ‘use patterns’ of the Hook model will vary depending on a product’s context. Thus, we investigate both the difference and similarities in the Hook model patterns for the two case study applications. Our particular focus is on examining the applications’ features and deconstructing their use cases. The objective is to analyze how the Hook model’s four stages are implemented in these use cases and to identify any patterns unique to each application. The comparative analysis of the two case studies helps us identify the patterns of the application of the model for the two products, highlight the similarities and differences, and arrive at a qualitative description of the necessary conditions and the mechanism of how the Hook model is implemented in practice.

1.1. Background

Many products rely on users forming the habit of using the product [3]. The Hook model attempts to describe and instruct on how the habituation can be incorporated via the product design process. The process is called habit-testing [2] and promotes a user-centered and iterative approach [4].

As shown in the Figure 1, the model is a four-step looped process that consists of a *Trigger* that actuates a certain user behavior, an *Action* that the user takes regarding the product, a *Reward* that the user receives in response to their *Action*, and an *Investment* that should encourage future use of the product. It is the last step that distinguishes the Hook model from the traditional habit-creation loop [5], and this is also the key feature that uses the leverage that digital products have. Investing some effort, social capital, data, money, or time adapts the product to user demand and creates an effect of ownership. Hence, the next time the user wishes to keep the “progress” or *Investments*, they react to the *Trigger*, which is not necessarily an external one, and return to the application to obtain their *Reward* again. Table 1 and the following paragraphs examine the four Hook model stages in more detail.

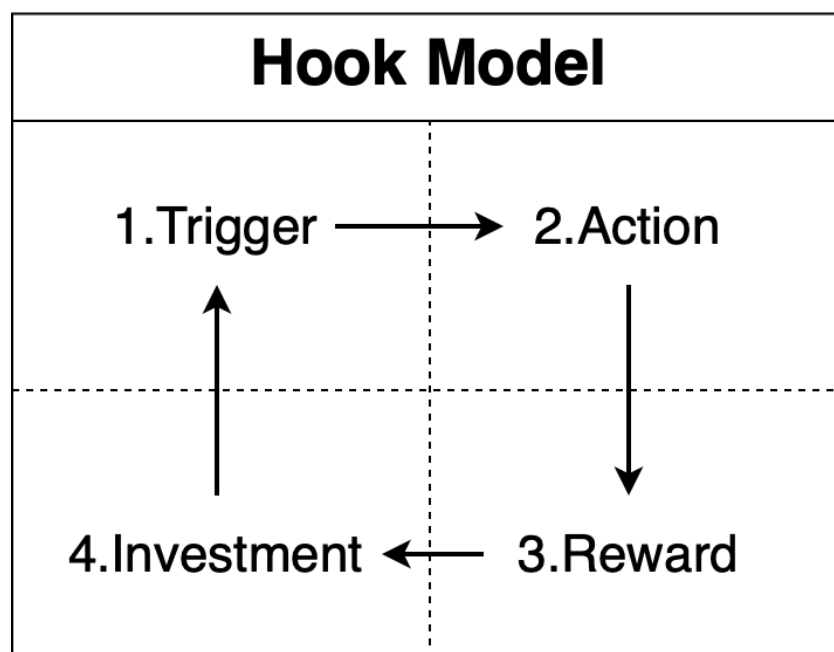


Figure 1. Hook model cycle: how digital products form habits.

The **first stage** is the *Trigger*: initially, it can be in the form of an external *Trigger*, for example, a notification, email, advertisement banner, or sound. The key idea is that it should bring the user to the product, and in a way is similar to the conditioning [6] used in associative learning—the famous Pavlovian conditioning [7]. In digital products [6,8], the most commonly used external *Triggers* are carried out via affecting the vision and hearing. External *Triggers* should be well-timed, actionable, and intriguing to work on a user [9].

After several repetitions of the habit-forming cycle, external *Triggers* should transform into internal *Triggers* in the form of a desire (coming from within) to use the product. The process of formation of individual *Triggers* is distinct for each person and is based on the user’s affordances, past experience, culture, and other similar aspects [10,11]. However, there are still common reactions (to a huge extent) for people of similar demographic groups, so, while creating *Triggers* and user interaction scenarios, the application designer refers to the target audience’s affordances. An example of an internal *Trigger* can be a person seeing a beautiful landscape and then proceeding to take a photo of it and post it on social networks. In this case, the external *Trigger* is not needed anymore—the *Action* is

performed in the presence of the unconditioned stimulus *Trigger* because the link “sensor condition–Action” is built.

The **second and third stages** of the Hook cycle are the *Action* and *Reward*. Prompted by a *Trigger*, the *Action* depends on the user’s motivation and ability [12,13]; therefore, generally a product must simplify the *Action* and make it as intuitive as possible. Intuitiveness in design is highly encouraged as it creates a desirable user experience [14]. The *Reward* should follow as a response to the *Action*. Interestingly, the joy of receiving a *Reward* is higher when there is an uncertainty of obtaining a *Reward*, i.e., when the *Reward* is variable [15]. It also could be explained that physiologically the joy is connected with the anticipation of the *Reward*, not the receipt itself [16,17]. Thus, the Hook model considers the anticipation of the *Reward* to be one of the key factors for users to be habituated to product use. Moreover, the *Action–Reward* sequence helps to create the internal *Triggers* associated with receiving a *Reward* in the form of the product value.

Eyal [2] mentions three types of *Rewards*: tribe, hunt, or self. The *Reward* of tribe means social acceptance, feeling joy from communication; the *Reward* of hunt means satisfaction from obtaining the result after searching and exerting effort; the *Reward* of self is connected to the feeling of self-excellence and self-significance. Social acceptance and achievements definitely play in favor of self-esteem [18]; therefore, the *Rewards* of tribe and hunt affirm and provoke receiving a *Reward* of self. In addition, the *Reward* of the hunt is close to the *Reward* of self, since both are about achieving a result—therefore, the hormone of joy, serotonin, is produced similarly. From the use cases, you can see that if the *Reward* includes a tribe, then it is also either a hunt or a self. If it does not include a tribe, it is still either hunt or self; therefore it all boils down to the *Reward* of self, a confirmation of self-worth.

The **fourth stage** in the Hook model is the *Investment* [2]. This stage is aimed to increase the value for users stored in the application. Another significant point here is that people prefer to keep the habit if there are efforts and sources that have already been invested in it. A user is not likely to move from one product to another with similar functionality as the first application already contains groups of people, history, and attachments. Therefore, this effect can either (or both) help keep users with the application or contrarily create a competitive strength that allows a user to transfer from a similar service to a new one with enough motivation. The Hook model is a type of persuasive technology. However, Hook focuses on creating a habit of application usage and aims to change behavior in this way, thus increasing the engagement, retention, and stickiness metrics numbers. Table 1 states the definitions of each Hook stage. The attribution of each use case to one of the stages is determined according to the specified definitions.

Table 1. Description of Hook cycle stages.

Hook Cycle Stage	Description
<i>Trigger</i>	a prompt to provoke an <i>Action</i> . Can be external (e.g., advertisement, notifications) or internal (e.g., a situational cue, boredom).
<i>Action</i>	the user’s interaction with the app’s functionality, usually in the search of a <i>Reward</i>
<i>Reward</i>	satisfaction (pleasure or release) as a result of an <i>Action</i> . The model emphasizes variability of the reward
<i>Investment</i>	the product’s ability to become more valuable as the user invests into the product (e.g., leaving a data “footprint”, better personalization, growing social network).

Importantly, the Hook model aims to engage the user within the application as much as possible. However, the ethical aspect of such application-creation techniques should be questioned. Several advisory models attempt to define the ethics of habit-forming products

[19]; however, reviewing them is outside the scope of this study. According to Verbeek [20], persuasive technology is a tool set that creates a specific relation of the user to reality, and there are two directions in which it can act: either shape the human attitude to the reality by managing the interpretation and perception of the human, or change the behavior of the user in reality, managing human *Actions*. Their technology can be considered as a mediator between human and reality. For a product team, these effects have to be measured through metrics based on the business goals [21] and customer objectives [22] and ideally directly tied to delivering customer value [23].

1.2. Related Work

The Hook model can be used in various contexts. Filippou et al. [24] apply the Hook model in combination with the behavior model in an educational app to help students build habits. That study emphasizes that to effectively apply the model, the designers should aim to reinforce specific behaviors. It would therefore be of interest to try concluding which behaviors are targeted with the two case study applications. Razi and Putra [25] combine the model with communication strategies in the context of a “Lost and Found” service and explores various types of rewards in a social setting. De Troyer et al. [26] use elements of Hook model in combination with the behavior model to counter school burnout phenomena in students and argue that a personalized approach should be taken in regards to applying the techniques.

Researchers also explore ways to expand the model, to make it more practical, and to counter its effects. Liu and Li [27] map the Hook model stages to axiomatic design theory (ADT) in an attempt to augment the model and provide a process of how habit formation can be designed from the point of view of ADT. However, they do not validate their suggested approach. Ertemel and Aydin [28] argue that the Hook model can be used to architect addiction and that to mitigate its effects individuals can act in the manner opposite to what the model suggests. Lastly, Yao [29] explores the use of the model within the popular WeChat application and concludes that one of the key aspects of the model is the necessity to iterate through the habit cycle as often as possible and that *Investment* plays a key role in increasing the probability of a new cycle.

However, to the best of our knowledge, *there is no research comparing how the use of the Hook model can vary depending on the context of the product*. Thus, the aim of this study is to fill the gap by identifying patterns of the application of the model for two different products, one being a popular taxi-ordering service (Uber (<https://www.uber.com/>, accessed on 26 April 2023)) and another a social media application (Instagram (<https://www.instagram.com/>, accessed on 26 April 2023)). The authors compare the use of Hook model techniques between the two applications and attempt a detailed qualitative description of the necessary conditions and the mechanism of how the user moves along the Hook cycle. The following section describes the methodology of data collection and the respective comparisons of the two products.

2. Methodology

2.1. Application Selection Criteria

We identify and explore the patterns of the Hook model in the two chosen applications, Instagram and Uber taxi. The rationale for selecting these applications is based on three aspects stated below:

2.1.1. Popularity

Nir Eyal (<https://www.nirandfar.com/>, accessed on 26 April 2023)) defined the Hook model as the result of exploring different examples of successful, worldwide popular applications that took a leader position and had high numbers in terms of daily active users, revenue, the total number of users, and other metrics. For our inquiry, it is also important to choose applications of similar popularity.

2.1.2. Platform

According to gs.statcounter.com (accessed on 26 April 2023) [30], the share of mobile devices in the international market is 14% higher than the share of desktop devices. Furthermore, mobile devices are always at hand. According to Fogg's behavioral model (<https://behaviormodel.org/>, accessed on 26 April 2023), this increases the possibility of an *Action* happening. Statistics [31] also shows that the market share of Android is around 75% and iOS, about 25%. We, therefore, decided to take Android into consideration.

1. Instagram [32]:
 - (a) total number of users = 1 billion (2020);
 - (b) daily active users = 500 million (Instagram Stories) (2020);
 - (c) revenue = USD20 billion (ads) (2019).
2. Uber [33]:
 - (a) total number of users = 93 million (2020);
 - (b) daily active users = 18.7 million (2020);
 - (c) revenue = USD11.14 billion (2020).

2.2. Pattern-Search Process

The process of pattern-search methodology is shown in Figure 2.

1. For each product, we build a use-case diagram.
2. Further, we examine each use case for the presence of Hook cycle stages. The *Trigger* for starting the use case, *Investments*, and *Rewards* obtained by the user are defined according to the Hook model stages definition.
3. We calculate the statistics of repetitions of the Hook cycle stage patterns in these use cases (internal patterns). Hence, we determine the percentage of patterns that are met in the use-case diagram for each of the case studies.
4. Then we look at the transitions between use cases, which are triggered by external patterns. The external pattern is a transition from a use case to the next one. The last Hook stage in the first use case and the first Hook stage in the second are taken as the beginning and end of an external transition, respectively.

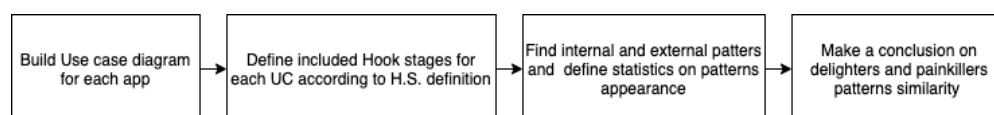


Figure 2. Process of pattern-search method.

The data for the sections of the features was manually researched through application functionality manual investigation and written down in the form of use cases. The connections/transitions from one feature to another were depicted in the use-case diagram in the form of association, extend, and include relations.

Hence, we know the proportions of transitions between the Hook stages inside the use cases, those inside the Hook cycle, and between different Hook cycles. Statistical data enable a comparison of how the Hook model is represented in both case studies; we qualitatively explain such differences.

3. Results

In this study, we searched for two types of patterns: internal (a combination of the *Trigger*, *Action*, *Investment*, and *Reward* stages within one use case) and external (transition between two use cases). To find the patterns, we have outlined most of the existing functionality of Instagram and Uber taxi through the use-case diagrams (see Appendix A). The use cases include most of the features and scenarios available in March 2021. Figures A2 and A4 in Appendix A provide mapping visualization by presenting each use case in the diagram as a combination of Hook stages.

The graph in Figure 3 shows the internal pattern statistics visualization based on the list of use cases presented in the diagrams. Table 2 counts the number of repetitions of each pattern (TAI, TAR, TAIR, AI) in the features (each use case). The figures show the patterns of transitions from one pattern component (Trigger, Action, Reward, Investment) to another, for example, the TAI pattern—transitions from Trigger to Action and to Investment sequentially within one case.

The next block (b) shows the internal and external patterns. The pink color shows the number of transitions between components in the original patterns. The pink numbers of transitions between components correspond to the sum of transitions between the components in different patterns, e.g., Trigger–Action = 32 = 17(TAI) + 6 (TAR) + 9 (TAIR).

Green represents the external transitions between the patterns from the case diagram (the link between the last component of one case and the first component of the next case). For example, if the first case is represented by the TAI pattern and the next case is represented by TARI, then the “external transition” is an Investment–Trigger (the last component of the first case is the first component of the second one). Block (c) shows the proportion of each transition between pattern components to the total number of transitions, separately for external and internal transitions.

Table 2. Number of occurrences of Hook stage patterns within the two products, and ration to all use cases.

Pattern	Instagram, Occurrences	Uber, Occurrences	Instagram, Ratio to All Use Cases	Uber, Ratio to All Use Cases
Trigger–Action–Investment	17	6	0.53	0.27
Action–Investment	0	6	0	0.27
Trigger–Action–Reward	6	5	0.19	0.23
Trigger–Action–Investment–Reward	9	5	0.28	0.23

3.1. Internal Patterns

To identify an internal pattern, a separate use case is taken, and then its stages are recorded as a pattern. Statistics on them are provided in Table 2. We visualize them in Figure 3 (percent—from the number of all use cases for each of the products).

Hook model stages patterns statistics

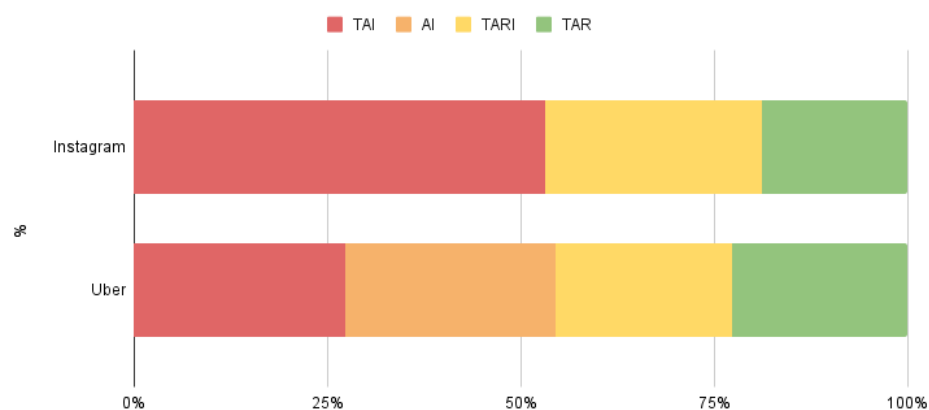


Figure 3. Internal patterns of Hook model stages within use case for Instagram and Uber.

TAI, AI, TARI, and TAR are abbreviations of Trigger–Action–Investment, Action–Investment, Trigger–Action–Reward–Investment, and Trigger–Action–Reward, respectively.

Table 2 is generated from the use cases that are presented in the use-case diagram.

The following observations are made:

1. The percentage of patterns *Trigger–Action–Reward* and *Trigger–Action–Reward–Investment* for both services are equal and are numerically about 23%. However, for Instagram, the TARI pattern is more common (28%).

We can conclude that on Instagram, the use cases are more complete, i.e., they include all stages of the Hook cycle and often combine both *Reward* and *Investment* at the same time. This means that the use case includes a full Hook cycle. This brings us to the conclusion that Instagram use cases are designed so that the user could become used to going through each use case separately. The goal is for them to become accustomed to utilizing at least a portion of the application, if not the entire application.

Note that the percentage of use cases with a *Reward* is the same for both products.

2. The patterns *Trigger–Action–Investment* and *Action–Investment* together represent about 53–54% for each product. However, the percentage of these patterns for each product varies greatly: TAI on Instagram—53%, on Uber—27%; AI on Instagram—0%, on Uber—27%. Recall that the *Trigger* that is taken into account if the context is internal (the desire or need to do something), and not external, since any clickable element can become an external *Trigger* during application use [2].

A possible explanation is that in Uber, when receiving a specific service, the user goes through a certain scenario (a chain of use cases) because it is necessary to receive the service (tunneling in persuasive technology). On Instagram, the user is free to do whatever they want, because their goal is not to complete a certain sequence of *Actions* to receive a service.

3. No certain pattern of *Investment* and *Reward* alteration was retrieved. By initial assumption, a *Reward* is assigned to the use case if there is a chance to obtain it, not a certainty. A user could repeat the use case, and thus Hook cycle several times before they reach the *Reward* (for example, open several recommended pages until finding some suitable). Therefore, it might be useful to check for users' behavioral patterns of how persistent they are when trying to obtain a *Reward* and conduct a UX experiment, but this is beyond this case study.
4. The *Investment* stage is more common than the *Reward* stage, according to statistics for the studied use cases, by 1.7 times (this is true for both products.)

The graph in Figure 4 shows the proportions of use cases containing *Reward*, *Investment*, or both stages at once.

This is important, because the *Action* stage is present in every use case, just as the *Trigger* stage, is with the exception of *Actions* that are performed by the user because they want to finish the *Action* to obtain the result; therefore they perform the *Actions* without extra *Triggers*.

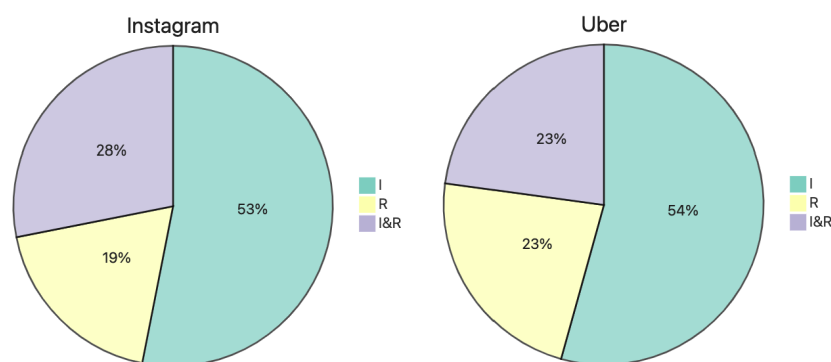


Figure 4. The number of use cases (UCs) containing *Investment* to the number of UCs containing *Reward* relates by 1.7.

3.2. External Patterns

To identify the external pattern, the connection between the transition between the two use cases is taken. The last stage of the Hook cycle, presented in the first use case, and the first, presented in the second use case, are considered as a start and finish point, respectively.

The following observations are made:

1. The transition from *Investment* to *Trigger* is similarly popular in both products—around 46%.
According to the Hook model this is the classical transition, and thus most expected to be met.
2. *Investment–Investment* is not so common. For Instagram, its share is only 7.5%, because, despite the large number of use cases that include *Investment* (for Instagram and Uber, the proportion of those including *Investment* stages from all presented is approximately equal—graph in Figure 4). Most of the use cases there begin with an internal *Trigger*.
Moreover, because the Instagram user does not have a “global goal” to obtain some specific benefit/service, they are constantly involved in the use of the application by provoking internal *Triggers*.
In Uber, many use cases start without the participation of an internal *Trigger* (about 31%), since the use cases are a logical continuation of each other—stages to achieve the goal and obtain the main *Reward*—so for Uber the percentage of such I–I patterns is much higher—35%.
3. The pattern *Reward–Trigger* in Instagram occurs as often as I–T—in 47.5% of cases. In Uber, this pattern is not popular—only 18%. Recall that the ratio of use cases with *Investment* to use cases with *Reward* is the same for both products. Therefore, such a difference in the presence of a pattern in the products can be explained by the fact that there are more variations in Instagram for the transition from a use case—greater graph connectivity. In Uber, there is the main scenario and several side ones, plus for many *Reward* is the final state of the use-case chain. Therefore, there are also fewer transitions from *Reward* to other use cases.

3.3. Hook Stage Pattern Conclusion

We draw conclusions based on the statistics (shown in Figure 5) of external and internal transitions. Figure 5a shows the internal pattern visualization. Statistics are provided in the graph in Figure 3. Figure 5b shows the total number of internal (pink) and external (green) transitions.

Internal occurs within one use case, thus one Hook cycle. Figure 5c shows the proportion of transitions, internal and external, that occur while moving from one Hook stage to another. We are mostly interested in performing analysis on this scheme.

Internal transitions: For both cases the transition sets are the same: *Trigger–Action–Investment*, *Action–Investment*, *Trigger–Action–Reward*, *Trigger–Action–Investment–Reward*. The proportion of TAI and AI differs greatly (Table 2); however, in sum these patterns make the same proportion of all presented patterns. The proportions of TAR and TARI are almost the same correspondingly for both products. This means that internal use cases for both cases could be designed applying Hook model patterns (TAI, TAR, TAIR, AI) with the same frequency of use (illustrated in the graph in Figure 3). The point is only that delighters include more *Investment*-containing use cases with *Triggers*, because through this *Trigger* a habit of use, a need, or a pain that could be solved via the application is formed.

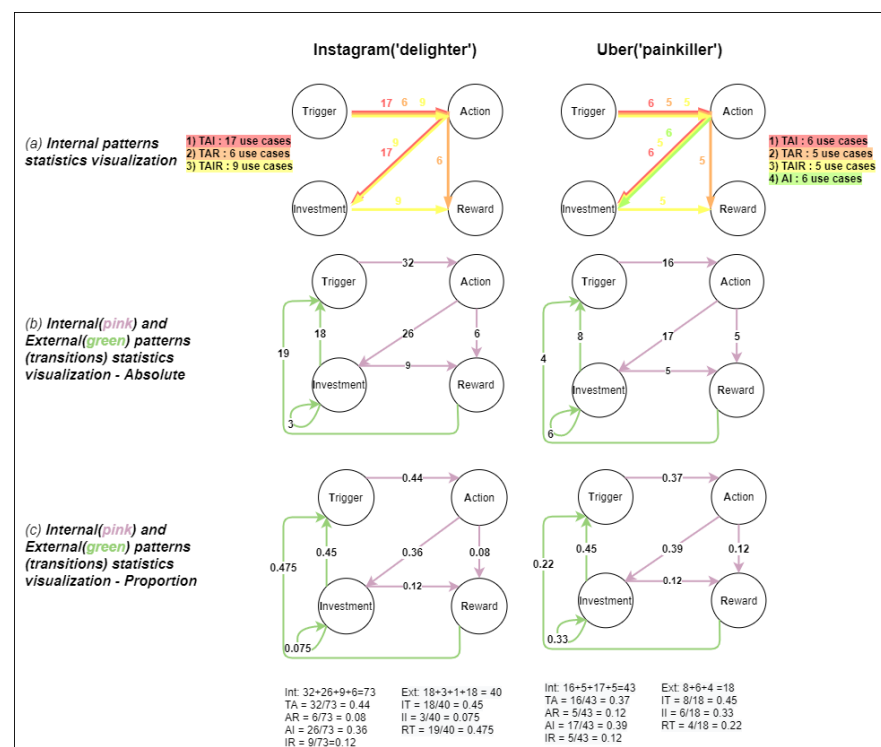


Figure 5. Statistics visualization of Hook cycle patterns.

External transitions: For Instagram and Uber taxi, the external transitions' presence proportions do vary. Only the transition *Investment–Trigger* has a similar proportion of presence (around 46%). For Instagram, the percentage of *Investment–Investment* transition is only 7.5%, whereas for Uber taxi it is high, 35%. *Reward–Trigger* for Instagram, on the contrary, is even more frequent than *I–T*—in 47.5% of cases. This means that in Instagram in the use cases chain, a new use case rarely starts without the participation of an internal *Trigger*, while in Uber they can more often advance through an application use case without additional internal *Triggers*. Thus, we can conclude that Uber actually needs fewer *Triggers* in designing the use cases because the application brings the user through the stages to receive the profit, the need for which triggered the user to initiate the interaction with the app. Moreover, the fact that the proportion of *R–T* transitions is two times less for Uber means that after receiving the *Reward*, the user stays and continues doing something in the app more rarely than the same happens in Instagram. Recall that the proportion of use cases that includes a *Reward* stage is the same for both types of products. This means that Instagram users are more likely to leave right after they obtain the *Reward*—they just do not return to application use with an internal *Trigger*. However, increasing the number of internal *Triggers* for applications such as Uber taxi might not be conceptually correct, because initially, this type of application's goal is to serve, not to keep the user inside the app. External *Triggers*, both in-app or outside, could be a good solution for bringing a user back.

However, some service applications (e.g., fintech services) increase internal *Triggers*' number while designing (stories, advertisement feature) to increase the time spent on the app, and this is a part of a monetization strategy based on advertising, self, and partners. With services such as Uber, it is generally an easier process of creating a habit of use: there is a profit, so the user will return, recommend it to others, etc. The user experience is important so that everything is "all-inclusive", seamless, and hassle-free, but this is a question of service design and UX design (this is also common for applications such as Instagram). Thus, the Hook model is not essential for the design of applications such as Uber taxi. However, the Hook model is successfully applied by the definition of Uber's use cases, although we do not have data that could confirm that Uber was designed according to the Hook model.

4. Discussion

Having studied the applications of the Hook model, we analyzed the internal and external patterns of the Hook stages in Instagram and Uber. Internal patterns are the combination of the Hook cycle stage inside one use case (Table 2), while external patterns are the transitions between use cases (Table 3).

Table 3. Statistics on transitions between UCs, also known as external patterns.

Transition between Stages from One Use Case to Another	Instagram, Occurrences	Uber, Occurrences	Instagram, Ratio to All Use Cases	Uber, Ratio to All Use Cases
<i>Investment–Trigger</i>	18	8	0.45	0.47
<i>Investment–Investment</i>	3	6	0.075	0.35
<i>Reward–Trigger</i>	19	3	0.475	0.18

Based on the analysis of internal patterns, we conclude that Uber is in less need of triggers than Instagram (Table 2). In Instagram, each action is preceded by a trigger, resulting in the prevalence of *Trigger–Action–Investment* (TAI) patterns, while Uber has an equal proportion of TAI and *Action–Investment* (AI) patterns. There is also a higher proportion of *Trigger–Action–Reward–Investment* (TARI) patterns (full cycles) for Instagram. Less complicated AI pattern *Actions* are common for Uber: they are the part of the decomposition of the process that the user must go through to receive the service, and the user does not need to spend extra strength for an emotional reaction. The initial *Trigger* that prompted the user to use the service is enough. An *Investment*-containing use case occurred 1.7 times more often than a *Reward*. The *Action* stage was present in each use case; a *Trigger* occurred in each for Instagram, but not so frequently for Uber. The proportion of *Investment*-containing patterns is greater than that for *Reward*. Thus, *Investment* increases the value of a product and keeps their interest in the application use via variability of the *Reward*: the user knows that they could receive the *Reward*, but this does not happen often; thus, they continue attempts to do so.

External patterns (transitions between use cases) demonstrate a similar trend with the prevalence of *Triggers* in Instagram. Instagram mostly transitions between the use cases to the *Trigger* stage, because the user does not have a specific purpose. For Uber, a chain of *Investment–Investment* external transition is characteristic because the user goes to the end of the chain of *Actions* to receive the service, and this simplifies the interaction—they do not need to experience unnecessary *Triggers*; the first *Trigger* of service is enough to obtain a result. In Uber, the *Reward–Trigger* transition is not so common: in fact, the Uber use-case graph has fewer connecting edges than that of Instagram, and Instagram has more options for what to do next after a certain use case.

As a result of the analysis, we created an elaborate scheme (Figure 6) of how the two products' functionalities incorporate the Hook model stages. The scheme reflects the mechanism for the formation of internal *Triggers*, various *Investment* options, and transformation of *Rewards*. This section includes the underlying mechanism (Figure 6) and several key observations on how the Hook model is applied in the two case-study products.

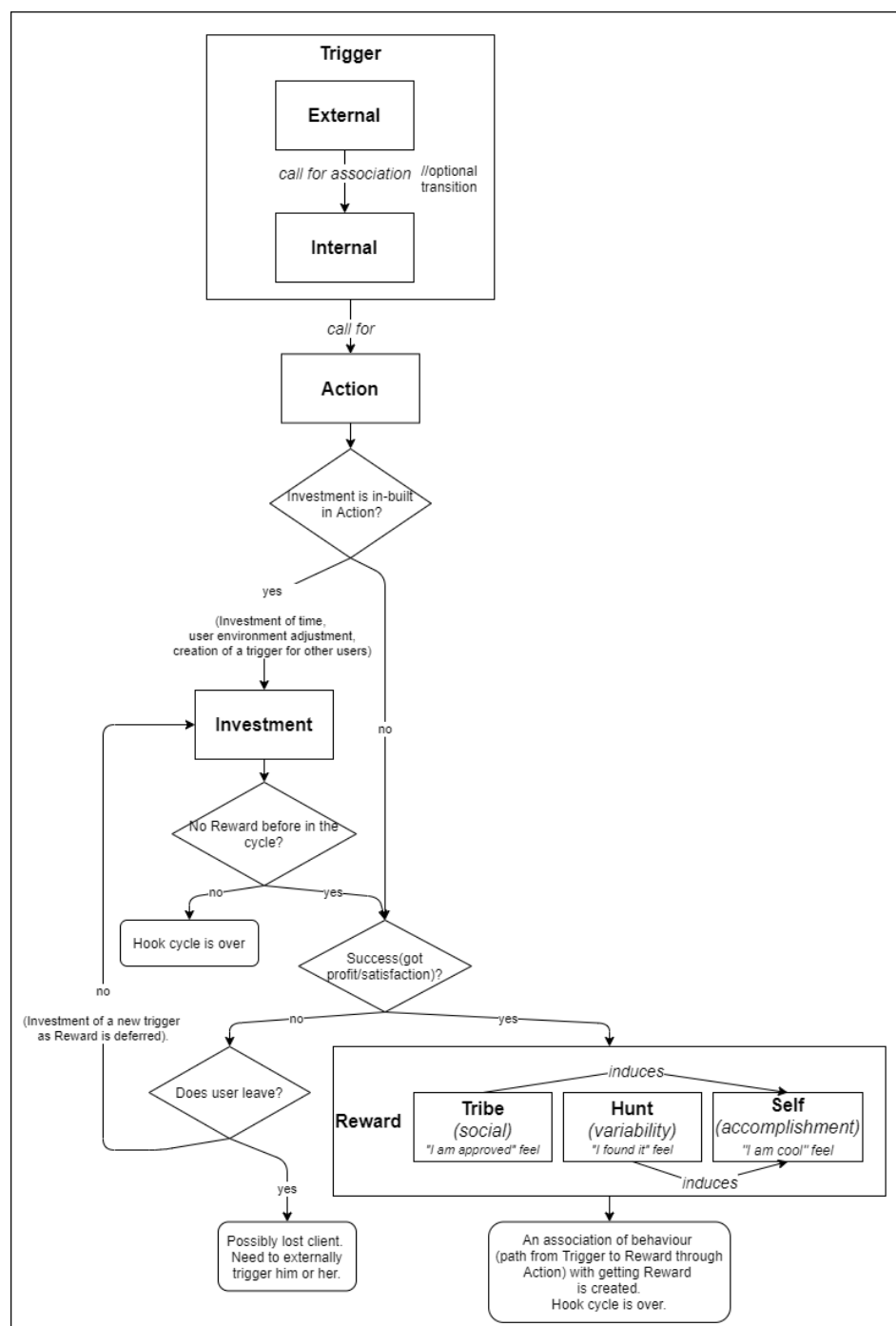


Figure 6. The Hook cycle mechanism observed during the case study.

4.1. Use External Triggers “Within” the Product to Promote or Diverge Usage Scenarios

Through the investigation, we have discovered that triggers can be placed within the product such that certain actions can be prompted or reinforced during the product use. This further adds to the notion of *Triggers* as formulated by Fogg [13] and adopted by Eyal [2].

An external *Trigger* prompts the user to perform an action and is part of the environment or the product. The goal is to appeal to the associative memory and provoke an internal *Trigger*, which is the user’s internal desire to perform the action. Importantly, external *Triggers* can be both “outside” and “within” the product. The former try to engage the user to use the product (e.g., notification, icon, email, mention in another application or verbal communication, etc.), while the latter are those that stimulate user advancement

through user scenarios during the interaction with the product (tips, instructions, clickable objects).

An external *Trigger* during the use of an IT product can be any interactive element within the product as long as it possesses the characteristics of discoverability and understandability [34]—in other words, if the user (a) can discover it on the screen (UI) and (b) understands that it can be clicked on and what will happen after (UX). Further, an external *Trigger* can both change the scenario of user behavior (e.g., watched story, went to private messages for discussion) and promote the user along the chain of use cases within one scenario (e.g., searched for an account by the nickname, opened an account, subscribed, opened a post, etc.).

The habituation still requires the creation of internal *Triggers*, as it reduces the cost of creating external *Triggers*, since the user forms a connection between using the product and relieving pain/receiving pleasure. An internal *Trigger* prompts the user to take an *Action*. Of course, this also poses ethical considerations, for which we have mentioned related work in the first section of the article.

4.2. An Investment Embedded in an Action Allows Us to Plant an Additional Trigger

Investment plays a critical role in the Hook model—the number of use cases with it is 1.7 times higher than the number of use cases with *Reward*. By definition, it is a “footprint” left by the user in the system: adjusting the environment (adding content, comments, friends (communication channels), editing personal account settings, etc.), time spent.

Interestingly, *Investment* is often embedded in the *Action* stage. An *Action* can result in an *Investment* when: (a) time and effort are spent on the *Action*, (b) personal data are shared that make the experience and product’s value higher, or (c) the user grows in the mastery of the product.

Furthermore, the *Investment* can lead to the creation of *Triggers* by the user themselves. At the *Investment* stage, the following *Triggers* can be created: (1) an internal *Trigger* for the user, if the execution of the *Action* did not lead to an immediate *Reward* and requires time (user writes a post and needs to go back and check how subscribers reacted, how many likes, what comments); or (2) an external *Trigger* for other users, if the result of the *Action*’s execution can be viewed and commented on in the sense of feedback (user writes a post and subscribers see it (external *Trigger*)). This external *Trigger* is associated with the internal one; therefore, it calls this internal *Trigger*, which already provokes the user (one of those, others) on the *Action* (saw the post—you need to look—like or comment). Thus, *Investment* for one user can be an external *Trigger* for other users if the result of the user’s activity is visible to them (e.g., message—another user *Triggered* to perform an *Action*: open app and message, read, and possibly reply).

This observation demonstrates how *Investment* is used to initiate new Hook cycles. The repetition of cycles is the key to habit formation, as is emphasized by Eyal [2] and Yao [29].

4.3. Failing to Receive a Reward Can Serve as a Trigger

Importantly, within the context of social media platforms such as Instagram, the failure to receive the *Reward* for an *Action* can become a trigger in itself in certain cases. When a user takes an *Action* and receives a *Reward*, an associative relationship is formed between the performed behavior (the path from *Trigger* to *Reward* through *Action*) and the *Reward* received, expressed in a sense of self-worth, acceptance by society, releasing pain or fear of being rejected, and delight of hope and acceptance. At the level of physiology, a neural connection is formed that will work the next time when the same *Trigger* is encountered on the user’s path, thus provoking the behavior; at the level of behaviorism, a connection is formed between the stimulus (*Trigger*) and response (behavior). This ensures that the user will re-initiate the Hook cycle in the future. Thus, the variability and distribution of the *Reward* can also be a significant factor.

However, if the *Reward* is not achieved as a result of *Action* performance, there are two options. The first option is that a new internal *Trigger* of dissatisfaction is created that

prompts the user to make another attempt to obtain the *Reward*, thus launching the next cycle (e.g., when looking through the suggestions on Instagram, a user continues to search and scroll because they hope that soon they finally should find something interesting; thus, the cycles are running one after another). Another option of behavior when the user does not receive the *Reward* is that they could leave the application, especially if they are not habituated to using it. To prevent this, external *Triggers* should be applied: notifications, emails, and even the icon on the main screen of the phone could help. The same approach is valid when a user leaves the application in any cycle stage, so they do not perform the cycle completely. This is needed to bring the user back to application use.

4.4. Ethics behind the Hook Model

Services should satisfy users' needs and try to produce positive emotions [35]. Applications such as Uber serve the actual need of users. The hook is designed to form an internal *Trigger* so when the context of their occurrence arises the service can satisfy the user's need. Instagram plays, on the contrary, on dissatisfaction with the variety of the *Reward*. When a user orders a taxi, the user expects that it will arrive and, if it does not, the user will be dissatisfied. When a user scrolls through Instagram in search of an interesting post, they also expect to find an interesting post. However, if the posts were all entirely interesting, after a while the user would have received good emotions and left Instagram. Therefore, since finding an interesting post is uncritical, the user continues to scroll the feed in the hope of finding something worthwhile.

In general, applications that resolve a real problem appeal to the positive emotions of people, because without receiving a solution to their real problem, users leave, while social services can use the feeling of dissatisfaction and the variability of the *Reward* to promote further use. It appears that one class of applications is ethical and the other is not. However, as we remember, issues of ethics are not legally regulated (if its violation occurs within the framework of legal methods) and remain on the conscience of the author of the product [19]. The use of the Hook model can be questioned in this context, because it is used mainly to transform the services into applications that create a habit or create a need for use. Further investigation is required to assess the ethics of using the Hook model in applications such as Instagram and to suggest best practices and guidelines.

5. Conclusions

The Hook model allows businesses to increase user engagement and retention by habituating the users to the product. In this study, we examined how the model is applied in two case study applications, namely Instagram and Uber, the former being a social network and the latter a taxi service. We looked into the functionality of the applications and reverse-engineered the use cases. Then we analyzed how the four stages of the Hook model are integrated into the use cases with the goal of identifying the patterns within each application. We drew the following insights from the comparison of the two applications.

Instagram more heavily relies on triggers, both within a single use case and also to transition between use cases. It appears that Uber requires fewer triggers as users come with a specific goal in mind. Moreover, the UI and functionality within the product can serve as *Triggers* that promote certain usage scenarios or drive the scenario into a new one. Any clickable interface element can serve as a *Trigger* if it is discoverable and the associated functionality is understandable.

Investment plays a crucial role in both products and is more prevalent than reward by 1.7 times. It is often embedded within *Actions* and can also be used to create new external *Triggers* for the user themselves and for other users. The most important role of the *Investment* is to promote future Hook cycles to build the habit and association between a need and the product.

Uber requires a stable delivery of the *Reward* as the result of an *Action*, otherwise it risks losing users due to dissatisfaction. However, Instagram can use failure to deliver a reward as an internal trigger itself, as the failure to deliver allows for the variability of

the *Reward*. An important question for future research can be what is the optimal variability ratio, how it should be calculated, and what are the effects on the user. Importantly, we highlight the greater relevance of ethical consideration in the case of Instagram, as it appears to exploit the users' dissatisfaction and triggers to engage the users.

Lastly, future research should explore the Hook model patterns in other applications, as the results of the current study are based on the study of two specific cases, which limits the possibility of generalization.

Author Contributions: Conceptualization, E.L. and N.A.; methodology, E.L.; investigation, resources, data curation, and validation, E.L.; writing—original draft preparation, E.L.; formal analysis and writing—review and editing, N.A. and H.A.; visualization, E.L. and N.A.; supervision, M.M.; All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A. Use Case Diagrams

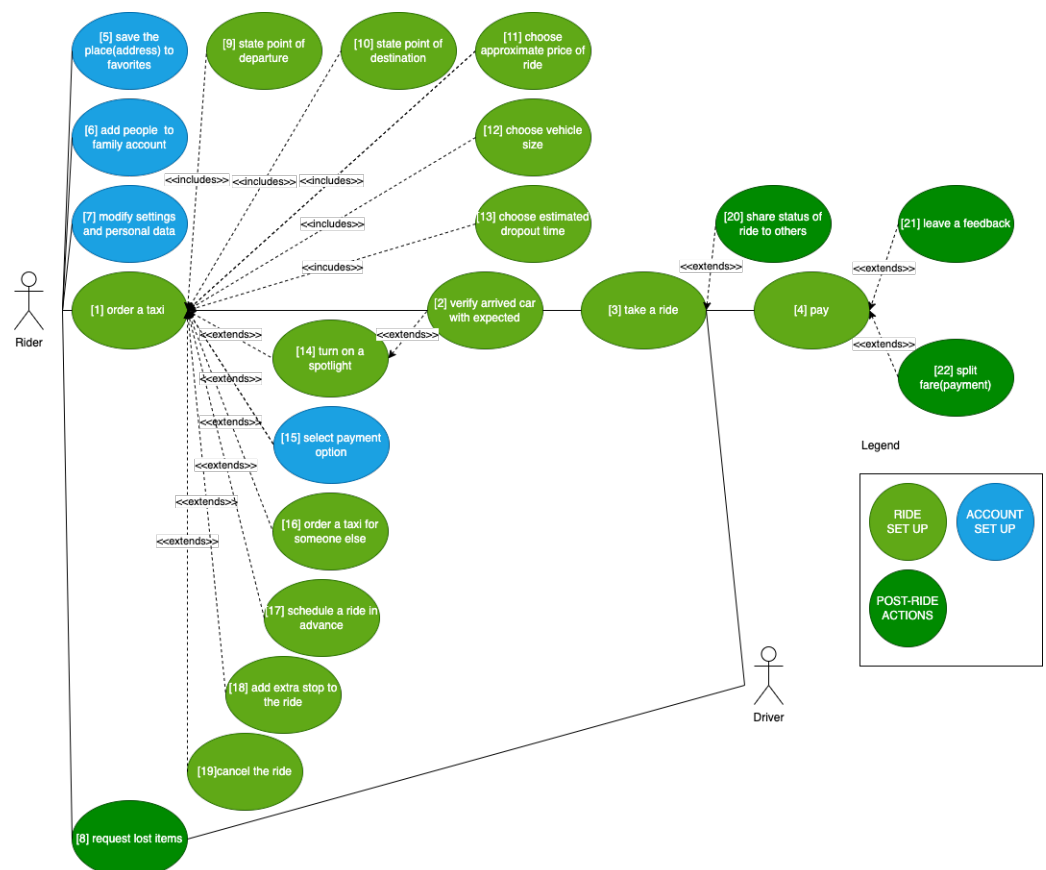


Figure A1. Uber taxi registered user (rider) use case diagram.

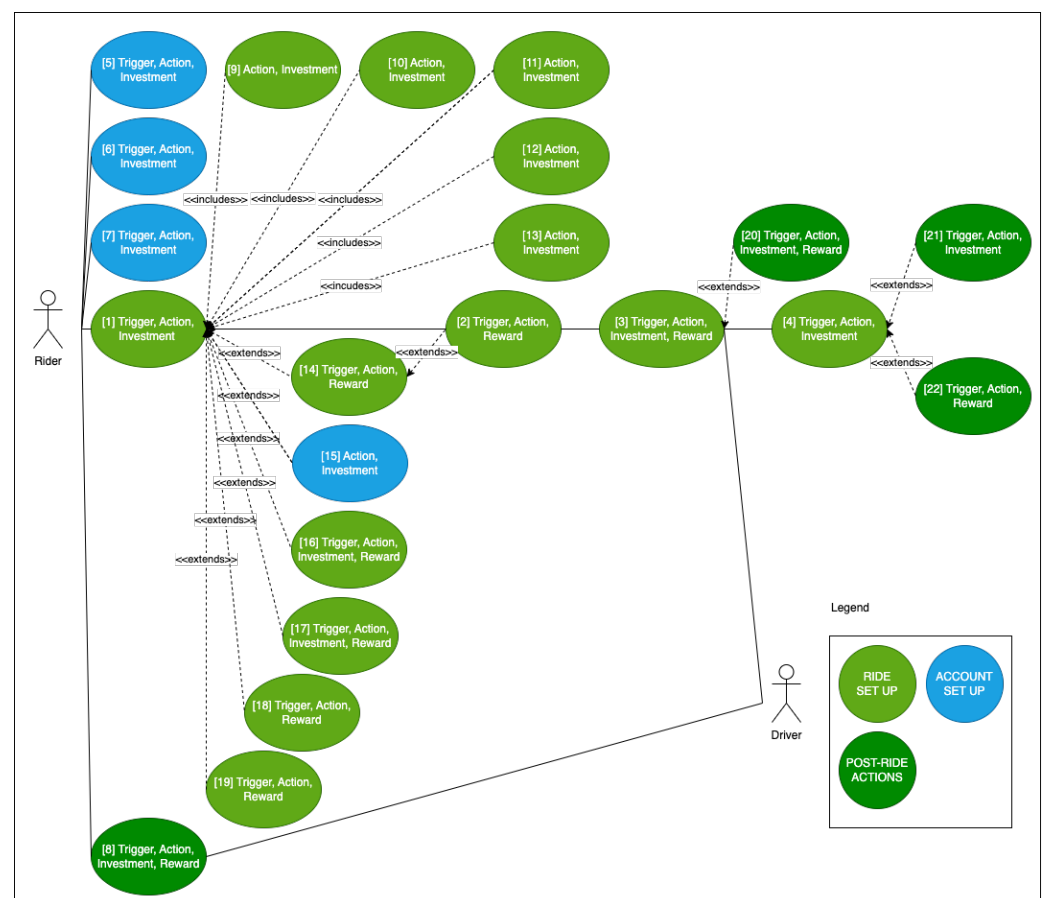


Figure A2. Visualization of Hook model stages mapped to Uber registered user (rider) use cases.

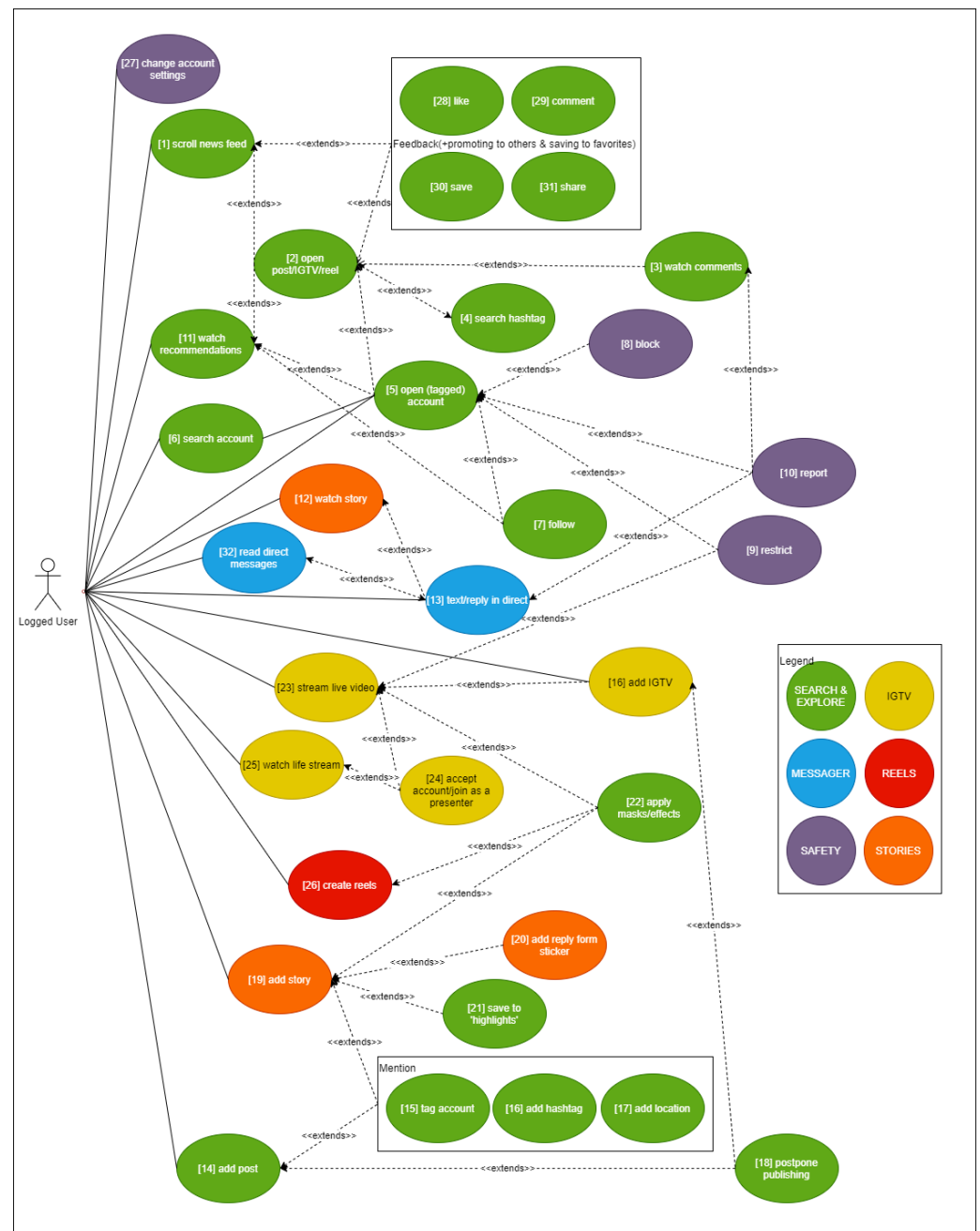


Figure A3. Instagram registered user use case diagram.

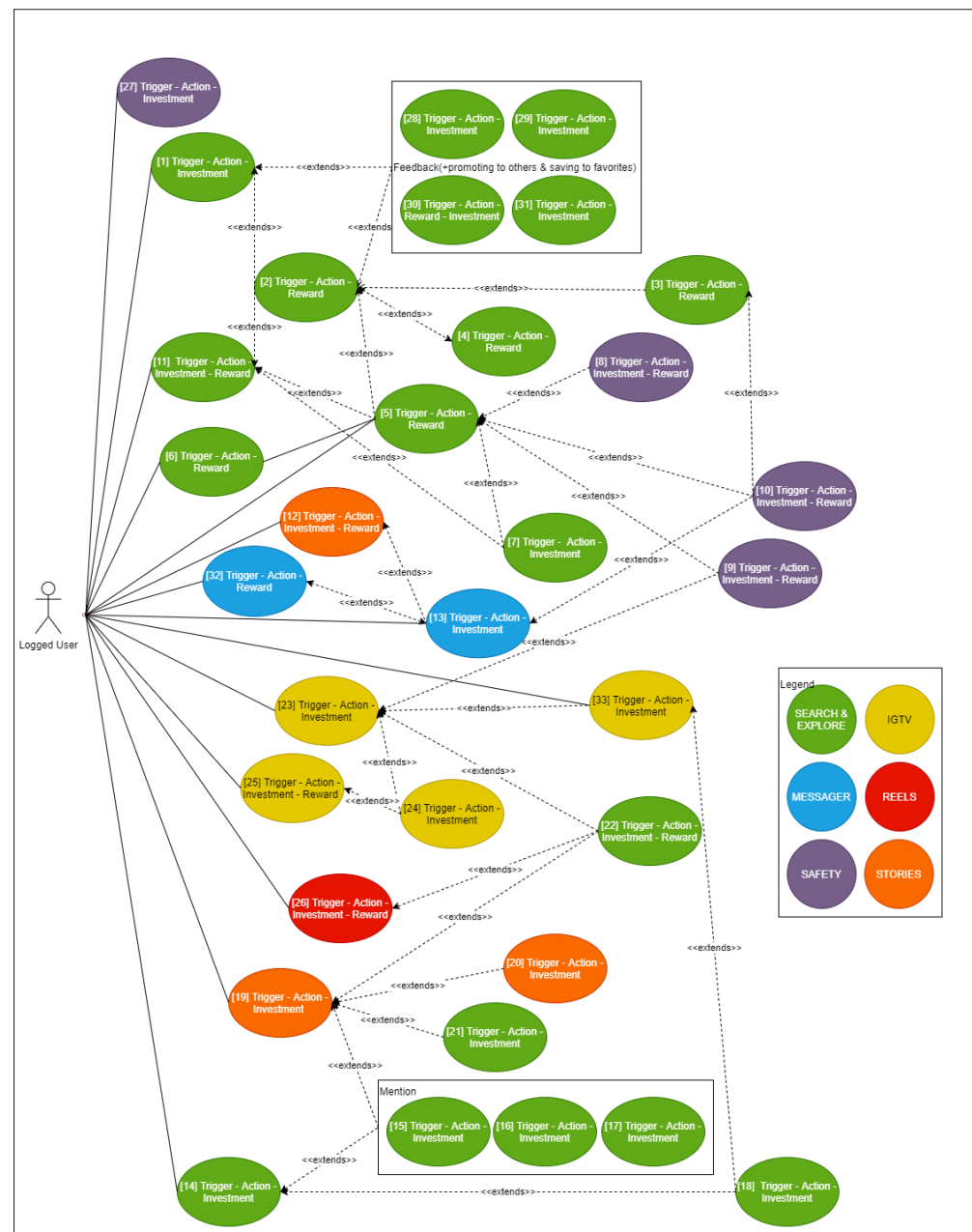


Figure A4. Visualization of Hook model stages mapped to Instagram registered user use cases.

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