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A dual-attitude model of system use: The effect of explicit and implicit attitudes

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ABSTRACT

This study advances the understanding of system use by suggesting that it can be driven by two types of attitudes. First, the often studied explicit attitude can be a basis upon which behavioral intentions are formed, and behavioral intentions drive system use. Second, the newly conceptualized and measured implicit attitude, which is triggered with limited or no awareness and intentional effort, can directly drive system use and serve as a basis upon which IS habit is formed. Explicit and implicit attitudes can uniquely explain variance in use behavior and act through separate mechanisms to influence system use.

"I had to stay home and read the textbook because if I go to the classroom or the lab that has computers, I will be spending most of my time on Facebook and Tumblr. Well…I never intend to use them, and they are not something I really enjoy with or benefit from, but if I notice an open browser in front of me the next thing I know I am online reading posts, replying, liking pictures, or checking profiles…"

– A student testimonial, March 2015

1. Introduction

The example above may resonate with many readers. Those familiar with mainstream information systems (IS) use research may also notice that the student's explanation was somewhat oxymoron – she had no behavioral intentions to use social networking sites ("I never intend to use them"), and her self-reported attitude toward these websites was not very favorable ("they are not something I really enjoy with or benefit from"), but, nevertheless, she would be using them. If attitude toward using the system was weak, and behavioral intentions were dormant, what drove system use behavior in her case? This question represents a problem with traditional rationale-based behavior models which we seek to address in this study.

It is well-established that system use is driven by explicit and mostly-rational processes of which users are largely aware and which are measured through self-reports. In this study, we suggest that the focus on purely explicit sets of antecedents of system use portrays only a partial picture of reality, and that supplementing this view with other types of predictors of system use, specifically implicit and subconscious, can augment our understanding of system use phenomena. To this end, we introduce implicit attitude and theoretically explain that it has the potential to directly drive system use by bypassing and influencing the often-studied rational decision-making mechanisms. Applying this proposed dual-attitude structure (explicit and implicit attitudes) to the abovementioned student statement, it is possible that while the student held a moderate or neutral explicit attitude toward social networking sites (SNS), she had a very positive implicit attitude toward them, and that this implicit attitude was triggered upon a mere exposure to a browser and drove automatic responses in the form of system use behavior.

Implicit attitude differs from explicit attitude in the ways it is formed, stored, retrieved, and operates. Explicit attitude toward an IS is a deliberately developed psychological evaluation of the IS, of which users are largely aware and which they may clearly describe in self-reports. Explicit attitude is constructed by means of a thoughtful process; people deliberately access relevant information in their memory, develop an evaluation (favorable or not) of an object (e.g., an IS) within the current context, become aware of their attitude, and can clearly describe it. In contrast, implicit attitude is a stable evaluation of an IS that is formed a-priori, is stored in special fast-access memory, and is

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activated with little or no conscious effort in response to internal or external stimuli associated with the attitude object. Its key attributes include limited awareness, subconsciousness, processing efficiency, fast accessibility, lack of intentionality, little control, intuition, slow learning and unlearning, context independence, and temporal stability [6,7,23].

While explicit and implicit attitudes differ, both can affect behavior, including presumably IS use, albeit through different mechanisms. Explicit attitude influences behavior through the formation of behavioral intentions [80,81,94], whereas implicit attitude operates through two mechanisms. First, it directly triggers behavioral responses (e.g., system use) without producing behavioral intentions. Second, it promotes the habituation of behaviors by providing users with easy to access cue-behavior associations. Implicit attitude is particularly salient in routine and high-familiarity technology use settings because of users' tendencies to save mental resources. Hence, it is important to extend the current IS research focus on explicit processes to include implicit ones; and this study seeks to make first strides in this direction.

Given the above-described nature of implicit attitude, one of the noteworthy challenges of accounting for it is its measurement. Explicit attitude is measured by directly soliciting responses from system users by means of surveys or interviews. In contrast, implicit attitude can only be measured indirectly, because it is usually beyond user awareness. In the present study, we measure implicit attitude by means of the Implicit Association Test (IAT) [37]. Explicit predictors of system use, namely explicit attitude and IS habit, as well as the outcomes of such predictors, i.e., behavioral intentions and system use, were captured through a survey of Facebook users. The results of Partial Least Squares (PLS) analyses lend support to the idea of dual attitude structures and to the hypothesized mutual, yet different, effects of explicit and implicit attitudes on system use. Consistent with prior IS research, it was found that explicit attitude has a positive effect on behavioral intentions, which in turn drive system use. The main contribution of this study is in extending this well-established view, and showing that implicit attitude can directly impact system use above and beyond the effect of explicit attitude and behavioral intentions; and that in addition, it can facilitate the development of IS habit, which moderates (suppresses) the effect of behavioral intentions on use.

2. Theoretical background

This study argues that IS user behavior can be driven not only by explicit attitude that users have toward an IS [80,81,94] but also by implicit attitude, of which users may be generally unaware. To advance this idea, this section first defines explicit and implicit attitudes and portrays the key differences between them. It then differentiates between implicit attitude and IS habit, presents the model of dual attitudes, and explains how implicit attitude can influence system use.

2.1. Implicit attitude

Attitude is a psychological evaluation of an object, a person, or a concept with some degree of favor or disfavor [20]. It has been often assumed that attitude informs deliberate and goal-oriented reasoning regarding action, which translates into intended behavior [1]. As such, previous IS research focused on explicit attitude of IS users [44]. Research, however, shows that people are not always fully aware of all of their attitudes that drive their actions [25,36]. Furthermore, people can simultaneously hold two types of attitudes toward the same object: explicit and implicit, which may or may not have the same magnitude and valence [64,65]. Thus, focusing solely on explicit attitude fails to portray a full picture of the factors that can influence actions and presumably also IS use.

Traditionally, explicit attitude has been a focus of IS research [95,96]. To construct explicit attitude toward a system, users engage in deliberate thoughtful processes, access system-pertinent information in their memory, develop a context-specific psychological evaluation of the system, and can, if asked, self-report their explicit attitude. Implicit attitude, as opposed to explicit one, does not require deliberate long-term memory access, and people have no control over the attitude retrieval process [35,37,39,83,88]. Implicit attitude is unconsciously triggered upon exposure to an attitude object or a cue, and as a result (1) is less subjected to deliberate influences, and (2) is not used in cognitive deliberation processes. Arguably, many IS, such as SNS, are often used automatically and without much cognitive deliberation [75,76,78,97–101], possibly at a mere exposure to a cue related to them (e.g., the sight of a browser window). Indeed, it has been shown that in the SNS context, people respond very fast and automatically to cues related to the IS through the activation of the reflexive brain system [77,102–105]. Users' limited awareness of implicit attitude, however, can prove to be challenging for researchers, because it means that this attitude cannot be accurately identified by means of self-reports in surveys and interviews.

Other differences between explicit and implicit attitudes include the fact that explicit attitude forms and changes quickly in response to stimuli from the environment (e.g., sequential updating processes), and it is affected by one's goals, recent encounters, current context, and motivations (e.g., in order to gain social approval in most Western societies, one would not purposely develop or express explicit sexist or racist attitude). In contrast, implicit attitude is formed through automatic subconscious pairings between an attitude object and related evaluations [63], and it is not influenced by one's goals and ulterior motives. Thus, implicit attitude can reflect personal and socially undesirable biases, whereas explicit attitude often fails to do so [27]. Consequently, explicit and implicit attitudes can differ in direction and magnitude, and one is not always a robust predictor of another [72]. For example, an employee may also hold a very negative implicit attitude toward an organizational system (because its use requires extra effort or he or she may resist change) but report a positive explicit attitude believing that the use of this system is expected and desirable.

2.2. Implicit attitude vs. IS habit

We posit that implicit attitude and IS habit are fundamentally different (see Table 1). In the Hypotheses section, we later explain how implicit attitude can form the basis for IS habit development.

Table 1
Differences between IS Habit and Implicit Attitude.

Dimension	IS Habit	Implicit Attitude
Conceptual Definition	Action representation in memory	Non-behavioral evaluation of objects
Acquisition Process	Frequent repetitive action in stable contexts	Various behavioral patterns, unique (single) emotional events, childhood experiences, deliberate thinking, reading, and passive socialization
User Awareness	Generally aware	Generally unaware
Control and Correction	Generally possible	Extremely difficult
Contextual Factors	Users are mostly aware of the contextual cues triggering their IS habit	Users are mostly unaware of the factors that develop and activate their implicit attitude
Goal-orientation	Goal-driven	Goal-neutral

There are at least six important differences between IS habit and implicit attitude. First, IS habit is defined as "the extent to which people tend to perform behaviors (use IS) automatically" [49, p. 709]. Thus, IS habit is a behavioral tendency, whereas implicit attitude is an automatically evoked stable psychological evaluation of an object (i.e., its mental representation). IS habit corresponds to a distinct action representation in a person's memory [32]. In contrast, implicit attitude includes a non-behavioral evaluation of an object.

Second, IS habit is acquired only through a slow, gradual process of incremental learning when performing repetitive behavior in a stable context [49]. Whereas implicit attitude may also result from repetitive behavioral patterns, it may also be produced by unique (single) emotional events, childhood experiences, deliberate thinking, reading, and passive socialization [61,62]. For example, a child may play a videogame only once, but if this episode is extremely positive, emotional, pleasant, and unique, he or she may quickly develop positive implicit attitude toward video games that may remain stable for decades. In contrast, he or she may need to play videogames for many days in the same setting to develop a related IS habit [106–108].

Third, people are generally aware of their IS habit or at least its behavioral effect, and their IS habit is mostly consistent with their explicit behavior and goals [97,109]. In contrast, people have limited or no awareness of their implicit attitude and its impact; when people's actions are driven by implicit attitude, their behavior may be inconsistent with their explicit attitude or with their goals [36,64]. For example, someone may know that he or she has a bad habit of accessing SNS on the smartphone while driving [75], yet be unaware that he or she has a very positive implicit attitude toward the SNS. As we explain later, it is possible that this implicit attitude has been responsible for the development of this habitual use behavior – checking the smartphone while driving, even though this behavior is inconsistent with one's key goals (e.g., stay safe).

Fourth, because people are aware of their IS habit, they may, at least to some extent, try to control or correct it. For example, habit-breaking intervention programs emphasize the development of better awareness of unwanted habits and their behavioral consequences [19,110]. However, implicit attitude is generally beyond people's awareness and is consequently very difficult to control and change.

Fifth, people are often aware of the contextual cues that trigger their IS habit [79,89,111]. Thus, they may deliberately avoid these cues to suppress an undesirable IS habit. In contrast, few people are aware of what leads to the development and activation of their implicit attitude because of the covert nature of the latter. Last, IS habit is generally goal-directed [49], whereas implicit attitude is goal-neutral. The initiation of a habitual act is usually directed toward a particular goal, while the subsequent actions may be automatic [90]. For example, people may develop a habit of taking a smartphone every time they leave the house, which is directed by the goal to stay connected. In contrast, implicit attitude is activated by exposure to goal-neutral cues related to an attitude object [63]; there is no deliberate intention or goal analysis involved.

2.3. The model of dual attitudes

The model of dual attitudes suggests that individuals can simultaneously possess explicit and implicit attitudes toward the same object [88], and that both of these attitudes can influence behavior, albeit through different mechanisms [27,65]. First, behaviors may be triggered by explicit processes, which are thoughtfully determined and controlled by a person. In this path, explicit attitude facilitates the development of behavioral intentions, which in turn drive behavior. An individual is fully aware of the explicit attitude and behavioral intentions, acts deliberately, and may provide the rationale for the behavior [1]. Second, behaviors can also be driven by implicit attitude. Implicit attitude, which is activated automatically upon exposure to a cue related to the attitude object (e.g., seeing an IS), may drive someone's behavior directly, without going through the deliberation path and developing intentions of which the person is aware. This model of dual attitudes has been frequently applied to explain explicit and implicit attitudes and processes in various contexts [33]. Therefore, this study focuses on this model and employs it as a lens of analysis for explaining IS use, not only from an explicit attitude standpoint, but also from an implicit attitude one.

The model suggests that behavior is a result of both implicit and explicit attitudes. Depending on the type of IS and users' personal characteristics, the relative effects of these attitudes vary. Implicit attitude is always the first, default response that is activated before explicit attitude is formed and expressed. This happens because implicit attitude is triggered automatically and without much effort, whereas the process of development and engagement of explicit attitude requires deliberate thinking and is cognitively slower. Human brains are wired in such a way that automatic responses precede deliberation, and deliberation is not always even initiated [7]. In addition, computer users are cognitive misers who want to minimize their cognitive load and conserve mental energy [29,87]. As a result, those who want to minimize their cognitive effort do not wish to create explicit attitude upon every exposure to relevant stimuli.

Implicit attitude is particularly salient in routine and high-familiarity technology use settings. In contrast, explicit attitude is highly influential when users engage in planned system use [1] especially, when individuals interact with new systems. This stems from the fact that the amount of cognitive processing required to generate and/or invoke attitude toward a system depends on the degree of user familiarity with it. When interacting with new systems, individuals are motivated to deliberately engage in cognitive processing to develop explicit attitude toward the system. In other words, they have to consciously weigh the system's pros and cons and make a thoughtful, planned decision. In contrast, when routinely dealing with familiar systems, people may not strive to cognitively process the characteristics of the system and assess their actions; instead, they try to minimize their cognitive load. As a result, instead of engaging in deliberate thinking to develop or reflect on explicit attitude, users may instantaneously invoke implicit attitude [40], which then directly triggers system use and bypasses rational decision-making processes. Hence, humans' natural gravitation toward mental-effort saving can drive them to rely more heavily on implicit attitude when engaging in routine use of familiar IS, whereas explicit attitude is more salient in the context of planned use.

For example, when a person just starts using Twitter, he or she needs to deliberately assess its usefulness, ease of use, enjoyment potential, etc. in order to form explicit attitude, which in turn drives behavioral intentions. Over time, as the user becomes very familiar with Twitter, he or she may not want to spend mental resources to assess this system every time when making a decision whether to use it. Instead, when being exposed to a situational cue (e.g., noticing a smartphone when taking a break from work), he or she may almost automatically retrieve implicit attitude from his or her memory (assuming it already exists), which can directly drive system use. Therefore, adding implicit attitude to models focusing on explicit processes is warranted. Note that, however, implicit attitude does not necessarily require repetition to form; it can be created after one exposure or even through non-direct experience with the system, e.g., by listening to others' comments. Nevertheless, repetitive system use and high familiarity with a system motivate the retrieval and activation of implicit attitude and demotivate the construction of explicit attitude.

In this study, we argue that it is possible that the existence of a dual-attitude structure may improve IS use models and perhaps explain the inconsistent role of attitude in system use processes. In essence, the disciplinary focus on explicit-only attitude limited our view regarding the role of attitude, as it focused on one type of attitude and ignored another. A majority of previous IS studies did not consider the explicit attitude→behavioral intentions relationship [46]; those that did so

often presented inconsistent findings on the role of explicit attitude as a mediator of the perceptions→behavioral intentions link [43]. Meta-analyses of studies based on the technology acceptance model show that the average strength of the explicit attitude→behavioral intentions relationship was only 0.18 [68], and it was not even observed in almost one-third of a set of examined works [74]. A possible explanation to the absent (or weak) effect of explicit attitude could lay in the potential existence of implicit attitude, which in certain contexts may be a partial or a primary driver of system use, and reduce or eliminate reliance on explicit attitude.

The model of dual attitudes has been shown to reliably account for both explicit and implicit processes across many behavioral domains, including response to sales pitches [12], smoking [18], voting [31], eating [67], and making ethical decisions [51]. Given this demonstrated cross-context validity and the fact that IS-related behaviors are often not conceptually different from those examined in past research (they also can be executed repeatedly and routinely), it is reasonable to assume that IS users develop implicit attitude toward the system and are prone to relying on implicit attitude when system use is routinized. We therefore apply the model of dual attitudes to an IS use context. We specifically focus on Facebook use, because many SNS users are very familiar with Facebook and employ it routinely without much deliberation [79]. In fact, evidence suggests that repetition and ongoing use of a system, which are important for the activation of implicit attitude, seem to be prevalent among SNS users [97].

3. Hypotheses

As per the model of dual attitudes, implicit attitude is the first, default attitude that is activated at a mere exposure to a system-related stimulus [26,88], and it has the potential to directly drive behavior [55,64,65]. This phenomenon (termed the "attitude-behavior highway") may be explained from the perspective of the Associative Memory Network Model of Implicit Attitude toward IS (Fig. 1), which adapts ideas from the connectionist [69,70], dual-processing memory [71], associative-propositional evaluation [33,34], and reflective-impulsive models [73] to the IS environment. First, it suggests that the human associative memory consists of nodes each of which represents a particular IT artifact (e.g., a computer, a browser, an application, or a smartphone). Nodes have properties, including implicit attitude toward a corresponding IT artifact if the person has developed such attitude based on direct use experience, exposure to emotional events, persuasion of others, passive socialization, observations, reading, deliberate thinking, and introspective evaluation and re-evaluation of previous use experiences. Second, these memory representations remain dormant until they are triggered by external or internal cues (i.e., stimuli). External cues refer to detectable visual (e.g., noticing the browser window), auditory (e.g., hearing a tweet notification), or sensory (e.g., accidentally touching a smartphone in a pocket) stimuli in the person's environment. Internal cues are users' voluntary or involuntary thoughts (e.g., a suddenly recalled image of a friend's picture recently seen on Instagram). These cues send activation signals to the appropriate nodes and activate them. When the node is activated, its implicit attitude is also triggered.

Third, most nodes are interconnected by associative links. For example, a node representing the Internet is generally linked with a node representing a computer, which in turn, is usually connected with nodes representing a printer, a USB key, and other computer devices. Most importantly, when people repetitively use IS to accomplish particular tasks, they develop associative links between a node representing the IT artifact and corresponding behavioral responses. For example, an HR head hunter who routinely uses LinkedIn to find suitable candidates may create an associative link between the node "candidate" and a behavioral response "search LinkedIn." When a node representing an IT artifact is activated, it also activates associative links leading to other connected nodes and behavioral responses within the network [4,14]. The process above is referred to as "spreading activation": one activated node sends activation signals to other nodes and behavioral responses [69].

Fourth, the strength and valence of the associative link between a memory representation of an IT artifact and a corresponding behavioral response is directly proportional to the strength and valence of the implicit attitude toward this IT artifact. In other words, implicit attitude determines the strength and valence of related spreading activation processes between the memory node and the corresponding behavioral response. When a mental representation of an IS is activated, it automatically triggers implicit attitude toward this system [33,36]. A strong positive implicit attitude should produce an automatic activation of the "engage, use, and approach" behavioral response, whereas a strong negative one should generate use avoidance actions [5,15,16]. For example, once activated, a strong positive implicit attitude toward Facebook is expected to immediately activate the preprogrammed use behavior schemata. In contrast, a strong negative implicit attitude toward a complicated enterprise resource planning (ERP) system can result in an automatic triggering of system avoidance, ignoring, or sabotage schemata. Because the stimulus→mental representation of an IT artifact

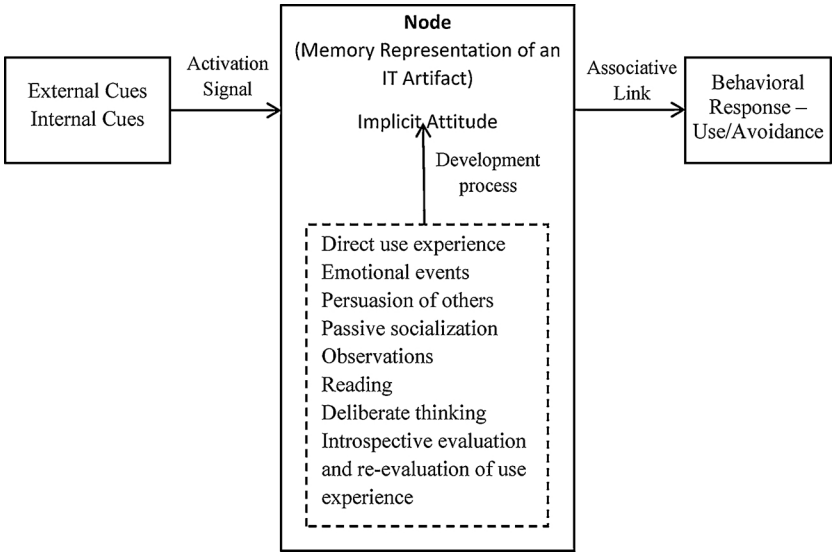

Fig. 1. The Associative Memory Network Model of Implicit Attitude toward IS.

(including its implicit attitude) →behavioral response path is activated instantaneously and uncontrollably, individuals may simply engage in use (or avoidance) behavior even though they did not engage in cognitive deliberation and did not intentionally plan to use (or ignore) the system. The existence of the direct implicit attitude→behavior link has been empirically confirmed in more than 100 studies conducted in various behavioral contexts (for a comprehensive review, see Cameron et al. [10] and Greenwald et al. [39]). Hence, the following hypothesis is proposed:

H1. Implicit attitude toward an IS is positively associated with the use of this IS.

Another way through which implicit attitude can influence behavior is through the development of IS habit. The notion that implicit attitude is the foundation for habit formation has been supported in various contexts of human behavior [2,3,50,84,85]. This happens because implicit attitude and its associated behaviors promote frequent repetition of the prescribed actions, which serve as a basis for IS habit formation. Indeed, it has been noted that habit formation results from the "incremental implicit learning of associations" [22, p. 722], and that "habits… [may be]… guided by implicit structures like schemas or implicit attitudes" [86, p. 232].

The present study further suggests that implicit attitude toward a system facilitates the development of IS habit by manipulating the strength of the associative link between system-relevant cues and corresponding habitual responses. People do not engage in habitual actions randomly; the execution of every habitual manifestation should be triggered by external (contextual, environmental) or internal (mental) cues [57]. Implicit attitude strengthens and makes it easier to retrieve the cue→habitual response link by executing respective behavior when the cue is present. That is, implicit attitude facilitates more frequent and less deliberate system use, and the more often users exhibit the same behavioral response upon exposure to the same cue, the stronger their mental association between this cue and a related behavioral response (i.e., habitual action) becomes [91].

With respect to the IS and particularly to the SNS context, it is suggested that a mere glimpse of a mobile device on the table may serve as a cue and activate a positive implicit attitude in the user's memory which, in turn, serves as a "mental reminder" to take the mobile device and check new messages (i.e., to execute a behavior when accidentally noticing the device) [109]. Moreover, the more frequently implicit attitude facilitates this action in the presence of relevant cues, the stronger the related associative link between the cues and the corresponding habitual actions becomes.[1] Thus, the following hypothesis is suggested:

H2. Implicit attitude toward an IS is positively associated with the habit of using this IS.

Consistent with and replicating previous IS research [46], it is proposed that:

H3. Explicit attitude toward using an IS is positively associated with behavioral intentions toward the use of this IS.

H4. Behavioral intentions toward using an IS are positively associated with the use of this IS.

System use is not perfectly predicted by behavioral intentions. In part, this happens because IS habit can weaken this relationship; the stronger the IS habit, the weaker the predictive power of behavioral intentions as a usage determinant [48,49]. The rationale is that habituation manifests in automaticity of the behavior, which, in turn, suppresses the need to engage in deliberate cognitive processes to activate this behavior. Therefore, it is hypothesized:

H5. IS habit moderates (suppresses) the effect of behavioral intentions toward using an IS on the use of this IS[2].

Fig. 2 visualizes the hypothesized structural relationships.

4. Methodology

This study involves capturing (1) explicit and (2) implicit attitudes and their outcomes, in the routine and high-familiarity use setting of Facebook. The first subsection below describes the information technology artifacts (two are needed as explained later) that were used in this study. Because implicit attitude cannot be measured by means of self-reports, the second subsection describes a technique, the IAT, for capturing implicit attitude. The third subsection outlines the specific implicit and explicit measures used in this study. The last subsection presents the procedures and the sample.

4.1. Examined systems

Attitude is a multi-dimensional construct composed of individual attributes (i.e., dimensions of judgment) [24,28,52,56]. When people are exposed to an IS, they identify one or more attributes associated with it and form beliefs about them. However, the attitudinal attributes vary in terms of their salience. Some of them may be extremely important whereas others may contribute very little to the composite attitude [47]. In other words, an overall attitude is a sum of its individual attributes where each attribute differs in terms of its magnitude and importance. Attitude toward some objects, including IS, may be comprised of a large number of attributes. For example, attitudinal attributes pertaining to Tableau (a business analytics application) may include functionality, intuitiveness, and reliability. Nevertheless, attitude toward other objects can be virtually unidimensional. For example, attitude toward videogames and SNS may be comprised of a dominating hedonic attribute because their primary purpose is the facilitation of enjoyment, and the other attitudinal attributes may become negligible. This study focuses on implicit attitude in the SNS context. SNS has high enjoyment potential [79]. Therefore, it is believed that the attitudinal component of enjoyment is the most salient in the present context, and it may be measured by means of the IAT.

The administration of the IAT requires the use of two systems toward which users develop attitude [37]: one that has a high enjoyment potential (the target category – Facebook) and another that produces neutral enjoyment (the contrast category). Particularly, it is critical that the contrast category be neutral in terms of its enjoyment potential – neither positive nor negative [60]. MS Excel was selected as an example of the contrast category because it is a work-related IT that focuses on productivity. It enhances the ability of users to organize, store, retrieve, process, and manipulate data. In contrast to Facebook, MS Excel does not purposely provide users with hedonic features and its use is mostly guided by utilitarian considerations. The application of the two-dimensional scale for the classification of IS by the context of use [13] further shows that Facebook and MS Excel are fundamentally different

[1] It is possible that in some IS contexts, IS habit and implicit attitude may not be correlated or even have opposite valences. For example, an employee may have a negative implicit attitude toward MS SharePoint because he or she perceives it as a source of unnecessary interruptions. Nevertheless, he or she may need to login into SharePoint every morning to review the schedule and receive assignments. Over time, the user may form a strong habit of logging into SharePoint at the beginning of every working day, despite having a strong negative implicit attitude toward this system. Thus, IS habit may contradict the implicit attitude→behavioral response path. However, such contexts are rare, and, generally, implicit attitude toward an IS has the potential to facilitate IS habit formation.

[2] Note that IS habit is not expected to moderate the relationship between implicit attitude and use. Implicit attitude does not trigger fully deliberate cognitive processes thereby eliminating a suppressing effect. Nevertheless, we later tested this moderation effect and did not observe it.

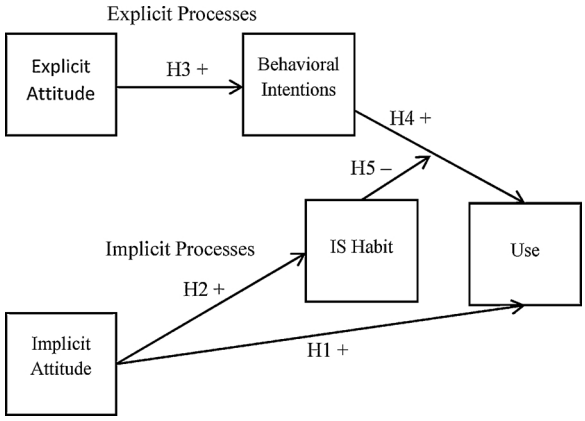

Fig. 2. The Model of Dual Attitudes.

– Facebook, on average, is high on pleasure and low on productivity, whereas MS Excel, on average, is high on productivity and low on pleasure[3]. Most importantly, MS Excel is not generally associated with positive or negative hedonic features – it is merely a productivity tool. This creates a large gap between the two applications in terms of their enjoyment potential, which is required for the administration of the IAT [60].

4.2. The implicit association test

The IAT is the most popular approach for the measurement of implicit attitude [27]. It overcomes the deficiencies of earlier techniques, such as evaluative priming. In contrast to self-report measures, individuals cannot typically intentionally control, fake, or influence the results of the IAT [5,21]. The purpose of the IAT is to measure differential association of two target concepts with an attribute. It is based on a logical assumption that the strength of association influences performance; people perform tasks faster and more accurately when they deal with well-practiced, stable cognitive associations in contrast to tasks in which cognitive associations are incongruent. This phenomenon is similar to communicating in a foreign language; even though most people can successfully use non-native languages, the process demands more cognitive resources, and, as a result, is slower and more error-prone.

A classic example of the IAT is the measurement of attitude toward flowers vs. that toward insects. Most people associate flowers (e.g., *tulip, rose, marigold, carnation, lily)* with pleasant words *(*e.g., *beautiful, good, positive, honest, nice*), and insects (e.g., *bee, wasp, horsefly, mosquito, locust*) with unpleasant words (e.g., *ugly, bad, negative, dishonest, awful*). *Flowers* and *insects* are considered *target constructs* (or *target concepts*), and *pleasant* and *unpleasant* words are considered *attribute categories*. When congruent pairs of words are presented (e.g., flowers + pleasant), people perform sorting tasks faster and more accurately than when the matching words are incongruent (e.g., insects + pleasant). The difference in performance (task completion time and error rate) determines a person's IAT score and the strength of his or her implicit attitude toward the target object [37]. When the pairs of words are congruent, the faster a person completes a set of sorting tasks and the fewer errors he or she has, the stronger his or her implicit attitude is. Note, however, that the example above applies to the measurement of differences in someone's attitude toward flowers vs. that toward insects. To measure the attitude toward flowers only, the contrast category must be neutral in valence [60].

The IAT includes five independent blocks, also referred to as tasks or trials (see Appendix A for the structure and illustration of the IAT). During a computerized test, construct and attribute words appear on the screen one by one, and participants should sort them into appropriate categories as fast as they can while making as few mistakes as possible by pressing the left or right keys. The categories (in the top left and top right corner of the screen) do not change within the block. The stimuli (in the center of the screen) change after the key is pressed; they are selected randomly, but the same stimulus cannot appear on the screen twice in a row. If the item is classified incorrectly, an error symbol appears on the screen, and the participant is advised to press an opposite key to correctly classify the item and to proceed further.

Blocks 1, 2, and 4 are only for practice (participants do not know this); the IAT score is calculated as the difference in performance on blocks 5 and 3. The rationale is that the stronger someone's implicit association between flowers and pleasant is, the faster and more accurately he or she sorts items in block 3 (i.e., when the association is congruent with the categories) compared to block 5 (i.e., when the association is incongruent with the categories). A high score shows more automatic positive evaluation of flowers compared with insects (i.e., more positive implicit attitude). The earlier versions of the test utilized seven blocks, when blocks 3 and 5 were split into the trial part and the measurement part. This approach, however, failed to produce conceptually distinct measures, and a five-block process is currently considered the gold standard [54].

For each person, the implicit association score, referred to as the IAT Effect or *D* statistic, is calculated based on the procedure developed by Greenwald et al. [38] (see Appendix A). Overall, the *D* statistic is based on reaction time and response accuracy, and it is indicative of the implicit attitude because people are expected to perform sorting tasks faster and more correctly in cases of stable cognitive associations than in cases of incongruent ones.

The IAT has been successfully used in various disciplines [e.g., 42,45,93]. The basis for such uses is the same idea as we present here – that people are generally unaware of their implicit attitude. Nevertheless, implicit attitude is part of a dual attitude structure and can influence behaviors [55,64,65], and, as argued in this study, also IS use. Therefore, the IAT was chosen as a means for capturing IS users' implicit attitude.

4.3. Measures

The *Free*IAT computerized test [53] was used to measure users' implicit attitude toward Facebook. It is a free open-source customizable software package for the administration of the IAT. *Free*IAT reports many parameters, including *D* statistic calculated based on the scoring algorithm of Greenwald et al. [38], *D* statistic calculated based on the first half of the stimuli, and *D* statistic calculated based on the second half of the stimuli. This software package has been used in many studies and has shown to be robust and reliable [e.g., see 30,41,66,92].

The target construct was Facebook, the contrast construct was MS Excel, and the attribute categories were Enjoyable and Unenjoyable, representing positive and negative valences toward these systems. These categories were selected because it is likely that in hedonic IS contexts associations between the stimuli and attitudes include enjoyment reflections [82] and the enjoyment context is frequently used in the IAT [60]. Words representing the target and contrast constructs were based on the most common features of each software system: Facebook (*friend, message, video, photo, chat, profile*) and MS Excel (*cell, formula, row, sheet, total, column*). Words reflecting the Enjoyable attribute category were adapted from the enjoyment scale by Davis [17] (*pleasurable, fun, exciting, interesting, entertaining, amusing*). For the Unenjoyable category, the most appropriate antonyms were selected from the Merriam-Webster Dictionary (*joyless, dull, boring, mundane,*

[3] It is still possible that some people may find the use of MS Excel to be somewhat enjoyable and consider its capabilities fun-facilitating. This, however, does not seem to be an issue. First, it is likely that only a minority of Excel users find the process of using this tool to be highly enjoyable. Second, on average, the enjoyment-evoking potential of Excel is expected to be much lower than that of Facebook.

ordinary, routine). Instructions were adapted from the *Free*IAT package and Project Implicit (http://www.projectimplicit.net). Appendix B presents the IAT and instructions used in this study. The IAT construct was measured with two reflective indicators: 1) *D* statistic based on the first half of the stimuli and 2) *D* statistic based on the second half of the stimuli, which are reported by the *Free*IAT software package. The test subjects should be familiar with both attitude objects (i.e., the target construct – Facebook and the contrast construct – MS Excel). However, the IAT score is not affected by their degree of familiarity with the attitude objects; instead, the score reflects the difference in performance between congruent and incongruent pairs because the score is calculated based on the differences in performance in Block 5 (Facebook + Unenjoyable) and Block 3 (Facebook + Enjoyable), whereas the other blocks are used only for practice or contrast purposes, and users' scores on the contrast construct (MS Excel) are therefore irrelevant.

Explicit attitude toward Facebook and Excel was measured by following Perugini [58], which is a common approach in the IAT design [51]. Six bipolar 7-point Likert-type scales were employed (*joyless-pleasurable; dull-fun; boring-exciting; mundane-interesting; ordinary-entertaining; routine-amusing*) for each IT artifact. Note that the same words were used to program the IAT to ensure the comparability of the implicit and explicit measures. The final measure reflecting explicit attitude toward Facebook was calculated by subtracting the Excel score from the Facebook score. Thus, this score was comparable to the IAT score, which was also (implicitly) obtained by contrasting Facebook with Excel and using Excel as the contrast category.

Behavioral intentions were measured by three items [76]: 1) I intend to use Facebook in the next 3 months; 2) I predict I would use Facebook in the next 3 months; and 3) I plan to use Facebook in the next 3 months. IS habit was measured with three items [49]: 1) Using Facebook has become automatic to me; 2) Using Facebook is natural to me; and 3) When I want to interact with friends and relatives, using Facebook is an obvious choice for me. The use construct was measured with three formative items pertaining to the subjects' general Facebook use behavior: 1) the number of times per day they access (e.g., check, post, view, etc.) Facebook (Daily Frequency); 2) the number of days per week they use Facebook (Weekly Extensiveness); and 3) usage comprehensiveness (Usage Comprehensiveness), which was calculated as the count of Facebook features and functions employed (meeting new people; staying in touch with close friends and relatives; staying in touch with people met on Facebook; posting messages; posting photos; reading messages sent by others; browsing the pages of people in the person's network; sending virtual gifts; playing online videogames; posting videos; and watching videos).

People sometimes under- or over-report behaviors that are considered negative or desirable, respectively, resulting in social desirability bias [81]. To account for it, a 13-item Marlowe-Crowne scale [59] was administered. A number of demographic and descriptive variables were also included for descriptive and control purposes.

To avoid a possible confounding effect of the order of tasks within the IAT, four versions of the test were developed in which the constructs and the attributes were assigned to the left and right keys in different sequences. In addition, approximately 50% of the participants completed the survey followed by the IAT, and the rest completed the IAT followed by the survey. Two versions of the survey instrument were created, one in which Facebook questions preceded Excel questions, and another with the opposite order. Overall, the experimental procedure was done in 16 different variations (i.e., 4 IAT versions x 2 survey/IAT vs. IAT/survey sequences x 2 survey versions – Facebook-Excel question sequence vs. Excel-Facebook question sequence). Participants were assigned to an experimental group randomly. Therefore, order-effect was minimized.

4.4. Procedure and sample

A sample of 251 students in a marketing class at a North American university was asked to participate in this study in exchange for course bonus points. Students were selected because they are presumably familiar with and use both IT artifacts. Moreover, many of them are likely to use Facebook intensively and routinely [79], which can be a basis for forming implicit attitude. The study involved two components: the IAT for capturing implicit attitude and an online survey for measuring explicit attitude, intentions, IS habit, and uses of which users are aware. The IAT was administered in a lab, preceded by a technical introduction and a demonstration by one of the authors. The online survey was taken before or after the IAT, depending on the sequence to which participants were assigned.

Out of these invitees, 181 agreed to participate and met the screening criteria. After removing incomplete and unreliable IAT and survey responses, 168 records were retained (net response rate of 67%). Fifty-five percent of the respondents were female, and the average age in the sample was 23 (from 18 to 53) years. On average, they employed Facebook for 4.4 years and accessed it six times per day, four days per week. They had on average 362 (from 3 to 2400) contacts in their Facebook account. The respondents also had 6.2 years of MS Excel experience and used it 2.4 days per week, on average.

5. Results

5.1. Preliminary assessment

First, a Multivariate Analysis of Variance (MANOVA) test was applied to all constructs of the model with the order of tasks as a fixed factor. It indicated that the order had no significant effect on construct values (Wilks' Lambda = 0.474, $p = 0.35$). Second, the potential effect of social desirability bias was examined. No statistically significant correlations were observed between social desirability scores and the model's constructs, which indicated that social desirability bias did not confound the findings. Because the outcome variable and implicit attitude were measured separately and by using different means, the risk of common method bias was mitigated. Third, the self-reported construct mean of explicit attitude toward Facebook was compared with that toward MS Excel. The results of a *t*-test revealed that the level of explicit attitude toward Facebook was much higher than that toward MS Excel (mean difference = 1.22, $t = 8.741$, $p < 0.001$). Because the attitude measures capture positive hedonic sentiment toward the IT artifact, the observed difference confirms that MS Excel produces a much lower hedonic sentiment compared with Facebook, and thus serves as a good contrast category in the IAT.

Fourth, the compatibility in direction and strength of explicit and implicit attitudes was examined for descriptive purposes. The correlation between these constructs was positive and medium ($r = 0.32$, $p < 0.001$). This demonstrated that explicit and implicit attitudes were mostly consistent in direction; yet, they had no close-to-perfect overlap in strength, which further illuminates the need to examine their separate effects. Fifth, descriptive statistics and reliability scores were calculated for the model's constructs (see Table 2). All Cronbach's Alpha, Composite Reliability (CR), and Average Variance Extracted (AVE) scores for the reflective constructs exceeded 0.7, the item-to-total correlations exceeded 0.5, and all loadings were above 0.7 (significant at $p < 0.01$). Moreover, discriminant and convergent validities were established with the correlation matrix and the matrix of loadings and cross-loadings. Table 3 shows that the square roots of AVE scores for each construct (on the diagonal) are larger than the corresponding correlations; and Table 4 reveals that all reflective construct loadings are greater than their cross-loadings. Thus, it was concluded that the scales were reliable and valid.

Note that a correlation of 0.26 between implicit attitude and behavioral intentions was observed. However, this does not imply a causal

Table 2
Item and Construct Statistics*.

Item	Item mean	Item std. dev.	Item-total corr.	Loading /weight	Std. Error	Alpha	Scale mean	CR	AVE
Explicit Attitude 1	1.61	1.99	0.85	0.88	0.01	0.94	1.66	0.95	0.75
Explicit Attitude 2	1.60	1.89	0.87	0.90	0.01				
Explicit Attitude 3	1.86	1.82	0.90	0.90	0.01				
Explicit Attitude 4	1.54	1.79	0.83	0.88	0.01				
Explicit Attitude 5	0.99	2.03	0.71	0.79	0.02				
Explicit Attitude 6	2.37	1.98	0.76	0.86	0.01				
Behavioral Intentions 1	5.22	1.91	0.96	0.95	0.01	0.98	5.26	0.98	0.93
Behavioral Intentions 2	5.33	1.88	0.97	0.98	0.00				
Behavioral Intentions 3	5.23	1.90	0.96	0.97	0.01				
Implicit Attitude 1	0.46	0.36	0.56	0.92	0.01	0.71	0.44	0.87	0.77
Implicit Attitude 2	0.42	0.31	0.56	0.84	0.02				
Habit 1	4.84	1.83	0.75	0.91	0.01	0.85	4.74	0.90	0.76
Habit 2	4.80	1.65	0.74	0.87	0.02				
Habit 3	4.57	1.79	0.65	0.83	0.02				
Daily Frequency	5.95	6.31	NA	0.15	0.01	NA	NA	NA	NA
Weekly Extensiveness	4.04	1.37	NA	0.74	0.02				
Usage Comprehensiveness	3.73	2.06	NA	0.33	0.03				

* All item loadings and weights are significant at $p < 0.01$. For the formative construct (Use that includes Daily Frequency, Weekly Extensiveness, and Usage Comprehensiveness), item weights are presented.

Table 3
Correlation Matrix and Discriminant Validity Assessment*,**,***.

Construct	Explicit Attitude	Behavioral Intentions	Implicit Attitude	Habit
Explicit Attitude	**0.87**			
Behavioral Intentions	0.42	**0.96**		
Implicit Attitude	0.32	0.26	**0.88**	
Habit	0.47	0.57	0.36	**0.87**
Use	0.40	0.60	0.36	0.64

* Items on the diagonal represent the square root of AVE.
** All correlations are significant at $p < 0.001$.
*** Use is a formative construct, and its AVE was not calculated (see subsection "Measures").

Table 4
Cross-loadings Matrix*.

	Explicit Attitude	Behavioral Intentions	Implicit Attitude	Habit	Use
Explicit Attitude 1	**0.88**	0.35	0.28	0.41	0.36
Explicit Attitude 2	**0.90**	0.31	0.31	0.45	0.40
Explicit Attitude 3	**0.90**	0.38	0.25	0.40	0.33
Explicit Attitude 4	**0.88**	0.38	0.28	0.38	0.32
Explicit Attitude 5	**0.79**	0.34	0.21	0.37	0.33
Explicit Attitude 6	**0.86**	0.42	0.33	0.43	0.34
Behavioral Intentions 1	0.40	**0.95**	0.26	0.53	0.56
Behavioral Intentions 2	0.40	**0.98**	0.25	0.56	0.60
Behavioral Intentions 3	0.42	**0.97**	0.25	0.57	0.58
Implicit Attitude 1	0.30	0.25	**0.92**	0.35	0.37
Implicit Attitude 2	0.26	0.20	**0.84**	0.27	0.24
Habit 1	0.37	0.62	0.35	**0.91**	0.65
Habit 2	0.39	0.41	0.33	**0.87**	0.52
Habit 3	0.49	0.44	0.24	**0.83**	0.49

* Use is a formative construct, and its loadings are not included in this table. For Use item weights, see Table 2.

relationship between these constructs. As theoretically expected, implicit attitude is correlated with explicit attitude, which, in turn, is correlated with behavioral intentions. Thus, it is reasonable to observe some degree of correlation between implicit attitude and behavioral intentions, though we do not hypothesize a direct effect.

Last, the formative construct (Use) was assessed using common guidelines [11]. Potential multicollinearity was examined with Variance Inflated Factor (VIF) scores. The VIF scores (1.2–1.4) were below the threshold of 3.33, indicating no significant overlap among the formative indicators. The loadings of the indicators were all in the same direction and significant at $p < 0.01$. Thus, the risk of nonsignificant weights and the co-occurrence of negative and positive indicator weights were ruled out. Ultimately, there is sufficient evidence to conclude that the formative composite is valid.

5.2. Model estimation

The proposed model was estimated with SmartPLS version 2.0.M3, using bootstrapping for generating *t*-statistic for path coefficients. The model was estimated in several steps in order to examine and compare the effects of implicit and explicit processes in isolation and together. The analysis commenced with the estimation of two competing base models – one that focuses on the effects of implicit attitude only (H1 and H2), and the other that focuses on the effects of explicit attitude only (H3 and H4). Based on the model of dual attitudes, Base Model 1 (Direct Effects of Implicit Attitude) is assumed to be the actual starting point, because implicit attitude is invoked faster than explicit attitude and is the default activation when exposed to a cue related to the attitude object. Nevertheless, there is merit in estimating Base Model 2 (Direct Effects of Explicit Attitude) as an alternative, because prior IS research has primarily portrayed this aspect of system use, and it is interesting to also consider how implicit processes can supplement this view.

These tests were followed by estimating two additional models. First, the "Moderated Intentions Effect" model extended Base Model 2 by including the IS habit construct and its moderating effect, i.e., this model focused on the relationships proposed in H2, H3, H4, and H5. The value of this model is in seeing how IS habit becomes dominant in routine and high-familiarity system use contexts, such as the one we examine. Note that IS habit was connected to system use because this is needed for modeling the moderation effect, and it is consistent with recent conceptualizations of the role of habit in IS use processes [8]. Second, in the last model ("Dual Attitudes Model"), both implicit and explicit processes were included, i.e., all of the hypothesized relationships. Table 5 presents the path coefficients, the explained variances, and the f^2 statistics (effect sizes). All path coefficients were significant at $p < 0.001$ and hence support all of the suggested hypotheses (see Fig. 3).

Several post-hoc analyses were performed with the intent to better understand the nature and effects of implicit processes in the examined

Table 5
Model Coefficients, Explained Variances, and Effect Sizes † (note: all values are significant at $p < 0.001$).

	Base Model 1 – Direct Effects of Implicit Attitude	Base Model 2 – Direct Effects of Explicit Attitude	Extended Base Model 2 – Moderated Intentions Effect	Dual Attitudes Model
Implicit Attitude → Use	0.38			0.13
Implicit Attitude → Habit	0.36		0.36	0.36
Explicit Attitude → Intentions		0.42	0.42	0.42
Intentions → Use		0.61	0.62	0.62
Habit → Use			0.74	0.71
Habit x Intentions → Use			−0.52	−0.54
$R^2_{Intentions}$		17.8%	17.8%	17.8%
R^2_{Habit}	12.9%		12.7%	12.8%
$R^2_{System\ Use}$	14.4%	36.9%	50.9%	52.3%
f^2 of Added Constructs	Baseline 1	Baseline 2	0.28	Against Base Model 1 = 0.79 Against Extended Base Model 2 = 0.03

† Effect sizes, f^2, were calculated using the formula [R^2(current model) - R^2(previous model)] / R^2(current model).

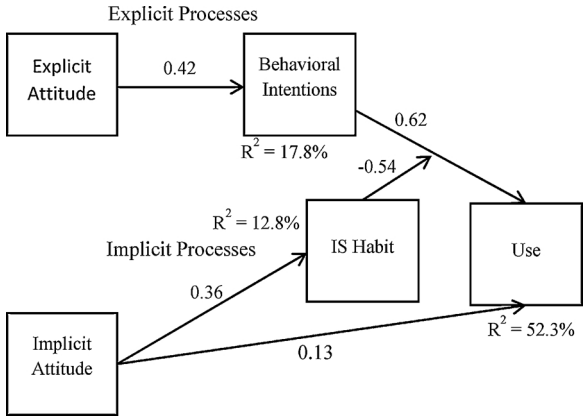

Fig. 3. The structural model – The Model of Dual Attitudes. (All path coefficients are significant at $p < 0.001$).

context. First, we tested whether implicit attitude moderates the explicit attitude→behavioral intentions→use relationship through IS habit (i.e., the mediated moderation effect) [112,113]. No evidence for this mediated moderation effect was found. In addition, no support was found that implicit attitude moderates the explicit attitude→behavioral intentions→use relationship when IS habit was excluded. Second, we tested whether IS habit moderates the implicit attitude→use path, but no support for this effect was observed.

In addition, the total effects of implicit and explicit attitudes on use were contrasted in order to shed light on their relative salience in this context. In isolation from explicit processes and IS habit, implicit attitude had a moderate impact on use ($\beta = 0.38$, $p < 0.001$). On its own, explicit attitude had a smaller total effect on use due to mediation through behavioral intentions (0.42 * 0.61 = 0.26). However, when IS habit was included as a moderator of the behavioral intentions→use relationship, the overall effect of explicit attitude on use became very small (0.42 * (0.62 – 0.52) = 0.04), because IS habit provides a countervailing force, which is consistent with prior research [49]. At the same time, the relationship between implicit attitude and use was not moderated by IS habit. Hence, not only implicit processes had relatively stronger effects on system use than explicit ones in the examined context, they also served as a basis for IS habit formation and through this mechanism weakened the effect of explicit attitude on system use. Hence, the role of implicit attitude in system use processes, at least in contexts similar to the ones we studied, is deemed to be multi-faceted and very important.

6. Discussion

This study hypothesized and empirically demonstrated that IS use, at least in familiar and routine use contexts, may be driven not only by explicit attitude but also by implicit attitude toward the system. For this, the model of dual attitudes [88] was adapted to the IS use context and tested with respect to a hedonic and habituated system (i.e., Facebook). The results support the proposed dual attitudes view and can be interpreted in two complementary ways.

First, considering Base Model 1 as a starting point, the findings imply that implicit attitude drives system use directly as well as indirectly through the promotion of IS habit. This mechanism alone explains 14.4% of the variance in system use, implying that in many cases users are also likely to engage in cognitive deliberation and generate and employ explicit attitude for guiding system use. Adding explicit processes to the base model has a major effect size and leads to explaining a major portion of the variance in system use (52.3%).

Second, using the models that were developed in previous IS research as a basis (Base Model 2 and Extended Base Model 2), we lend support to past findings that explicit attitude influences system use through intentions, and that the effect of intentions on use is weakened by IS habit. After accounting for such effects, implicit attitude predicts system use directly with a small-medium effect size, as well as influences it indirectly by serving as a basis upon which IS habit is formed. Moreover, IS habit does not limit the predictive power of implicit attitude, and the "attitude-behavior highway" is shown to exist in IS use contexts.

Amalgamating both perspectives, the findings show that familiar and routine system use is mutually guided by (1) users' implicit attitude and (2) deliberate reasoning and reflections on one's explicit attitude. Implicit attitude is important because it not only drives system use directly (the "attitude-behavior highway") but also promotes the development of IS habit. Hence, models that include implicit attitude have the potential for increasing the explanatory power of explicit-process-only models and portraying a more complete picture of the processes leading to system use.

6.1. Contribution to theory

First, this study demonstrated that by focusing solely on explicit attitude and perceptions when trying to explain system use, IS researchers portray only part of the picture. As per the findings, IS users may also have an implicit set of attitudes which can also drive system use. Including both implicit and explicit attitudes in models explaining system use can improve the understanding of user behaviors, increase variance explained in system use, and shed light on the processes leading to less deliberated, routine IS use behaviors, which seem to be prevalent in the modern society.

The findings in essence point to an overlooked implicit mechanism that has the potential to influence system use phenomena. Many previous IS studies excluded the explicit attitude→behavioral intentions

relationship from their models [46]. When considered, this relationship was often very weak or nonexistent [43,68,74]. While this weak association may be due in part to the habituation of IS use [49], it may be also explained by the fact that previous research focused on users' explicit attitude. The current study showed that implicit attitude can also influence IS use behavior, over and above the effects of explicit attitude and habituation as mediated by behavioral intentions. Thus, future research should account for and expand on the roles of both types of attitudes.

Second, this study advances the understanding of the role of IS habit in user-system interactions. Implicit attitude not only directly leads to system use but also facilitates the development of IS habit (β = 0.36, $p < 0.001$). Implicit attitude triggers the execution of repetitive behavior in the presence of a cue, which strengthens an associative link between this cue and an automatic response. This extends the body of knowledge regarding the antecedents of IS habit in user-system interactions and can serve as a basis for future research on IS habit development.

Third, replicating prior findings [49], this study revealed that the influence of behavioral intentions on use is suppressed by IS habit (β = -0.54, $p < 0.001$). As a result, the total effect of explicit attitude on use, fully mediated through behavioral intentions, is very small (0.04) because IS habit decreases the predictive power of explicit attitude by acting as a countervailing force. In contrast, IS habit does not moderate the relationship between implicit attitude and use (β = -0.08, t = 0.887, n.s.). A possible explanation is that implicit attitude is fundamentally different from IS habit, operates differently, may have a different valence, has different underlying processes, and exhibits different levels of awareness (as described in Table 1). This is further demonstrated by the fact that IS habit was only moderately correlated with implicit attitude (r = 0.36, $p < 0.001$). Hence, it was shown conceptually and empirically that IS habit and implicit attitude are distinct concepts that influence IS use through different mechanisms. They may therfore be studied simulatniously and/or sperately in future research.

Fourth, this study contributes to the psychology literature by extending the validity of the IAT and the model of dual attitudes to a new behavioral context (IS use). As argued by Blanton et al. [9] and by Fazio and Olson [27], more evidence is needed to confirm the predictive validity of the IAT within the discipline of psychology and beyond. Ultimately, this study shows that implicit attitude can play an important role in explaining IS user behavior, extends the known effects of implicit attitude, advances IS research to less deliberated behavioral domains, and points to the need to further incorporate implicit processes in IS research.

6.2. Contribution to practice

This study's findings also point to several practical recommendations. The prevailing view has been that people make a decision to use a system based on their explicit attitude that is developed based on their direct interaction with a system. Therefore, developers focused on system elements that promote positive explicit perceptions and attitudes toward the system. However, the present study demonstrates that system use is also directly driven by users' implicit attitude. Prior research posits that individuals may form strong implicit attitude toward a system without direct experience [61], e.g., by observing others, reading testimonials, and discussing the system with colleagues. Thus, when people approach a new system, they may already possess implicit attitude toward it, which may be triggered instantaneously and uncontrollably.

System developers and managers, therefore, can try facilitating the triggering of positive implicit attitude toward the target system. They can do so not only by changing system features and functionalities but also by creating a halo around or a general positive opinion regarding the system. Thus, IS practitioners should monitor the information that may lead to the formation of implicit attitude; e.g., by running sentiment analyses of users' opinions as expressed in a blog. They may also seek an active role in promoting positive implicit attitude by communicating encouraging information and feedback to employees. In addition, employers can provide cues that trigger implicit attitude toward important organizational systems, e.g., by putting reminders on screensavers. The efficacy of such strategies, though, should be examined in future research.

In organizational settings, managers generally want their employees to use IS routinely and habitually. As demonstrated in the present study, implicit attitude leads to the formation of IS habit, and IS habit, in turn, promotes automatic use by suppressing the impact of behavioral intentions on use. However, a low or negative implicit attitude is unlikely to produce a desired IS habit, and in this case, system use is mostly driven by explicit attitude. Thus, IS managers should closely monitor the level of implicit attitude toward a system of their employees and ensure that it is always strong and positive.

This study also demonstrated that the IAT may be used to measure the implicit attitude of employees toward most IS. In some cases, employees may not want to openly express their negative explicit attitude, but their implicit one may reveal their true sentiment. The administration of the IAT is a very simple procedure which takes only a few minutes. Thus, the IAT may become a useful tool for managers who want to obtain an unbiased measure of their employees' attitude toward a system.

6.3. Limitations

Despite its contribution, this study had a number of limitations. First, the research model was tested in a single context (i.e., hedonic and high-familiarity). This context was chosen because it is prone to invoke implicit attitude which may be easily measured by means of the IAT. Whereas the attitude toward the hedonic system, such as Facebook, is virtually unidimensional, attitude toward other SNS may consist of several attitudinal components. The use of some systems may be driven, at least to some extent, not only by hedonic but also by utilitarian values. In this case, the unidimensional construct of hedonic attitude may not fully capture users' attitude toward the system, and each attitudinal component should be measured with an individual IAT. Thus, future research should explore multidimensional attitude structures. Second, the balance between implicit and explicit processes may be context-dependent. Thus, whereas this study's model was demonstrated to be valid in a hedonic context, it may need further adjustments in other contexts, especially when system use is more planned. Third, while in this study we theoretically and empirically integrated implicit attitude with the key explicit predictors of system use, it is important to examine a broader set of explicit predictors of use and predictors of implicit attitude, e.g., personal user characteristics, and integrate other explicit factors with implicit processes. Fourth, the present study did not find a moderation effect of implicit attitude on explicit processes. This, however, does not rule out a possibility that this moderation effect may exist, especially in other IS use contexts. Fifth, consistent with previous IS research, this study did not separate planned use (driven by explicit attitude) from unplanned or spontaneous use (driven by implicit attitude; see [76,78,100,105]). Future scholars should therefore examine the differential roles of these attitudes in planned and unplanned IS use.

7. Conclusion

This study demonstrated that IS users hold two types of attitudes: implicit, which can directly and through habituation affect system use, and explicit, which drives system use through the formation of behavioral intentions. As such, implicit attitude can trigger system use without having individuals to cognitively develop behavioral intentions, and IS users can engage the "attitude-behavior highway" when

exposed to cues associated with the IS. Consequently, the model of dual attitudes enriches the prevailing view regarding system use, which focuses mostly on deliberate processes, and it portrays a more complete picture regarding factors affecting system use. In addition, this study demonstrated the application of the IAT, which may be used to measure users' implicit attitude. By relying on this novel concept and measurement technique, IS theory may be extended further to improve our understanding of the factors, including those of which users are less aware, driving the use of IS. Ultimately, this study can serve as a platform for further understanding implicit processes in user-system interactions.

Appendix A and Appendix B. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.im.2018.10.009.

References

[1] I. Ajzen, Nature and operation of attitudes, Annu. Rev. Psychol. 52 (1) (2001) 27–58.
[2] S.L. Ames, J.L. Grenard, Q. He, A.W. Stacy, S.W. Wong, L. Xiao, G. Xue, A. Bechara, Functional imaging of an alcohol-implicit association test (IAT), Addict. Biol. 19 (3) (2014) 467–481.
[3] S.L. Ames, J.L. Grenard, A.W. Stacy, L. Xiao, Q. He, S.W. Wong, G. Xue, R.W. Wiers, A. Bechara, Functional imaging of implicit marijuana associations during performance on an Implicit Association Test (IAT), Behav. Brain Res. 256 (November) (2013) 494–502.
[4] J.R. Anderson, A spreading activation theory of memory, J. Verbal Learn. Verbal Behav. 22 (3) (1983) 261–295.
[5] R. Banse, J. Seise, N. Zerbes, Implicit attitudes towards homosexuality: reliability, validity, and controllability of the IAT, Exp. Psychol. 48 (2) (2001) 145–160.
[6] J.A. Bargh, Four horsemen of automaticity: awareness, efficiency, intention, and control in social cognition, in: R.S. Wyer, Jr.T.K. Srull (Eds.), Handbook of Social Cognition, Erlbaum, Hillsdale, NJ, 1994, pp. 1–40.
[7] A. Bechara, A.R. Damasio, The somatic marker hypothesis: a neural theory of economic decision, Games Econ. Behav. 52 (2) (2005) 336–372.
[8] A. Bhattacherjee, C.-P. Lin, A unified model of IT continuance: three complementary perspectives and crossover effects, Eur. J. Inf. Syst. 24 (4) (2015) 364–373.
[9] H. Blanton, J. Jaccard, J. Klick, B. Mellers, G. Mitchell, P.E. Tetlock, Strong claims and weak evidence: reassessing the predictive validity of the IAT, J. Appl. Psychol. 94 (3) (2009) 567–582.
[10] C. Cameron, J. Brown-Iannuzzi, B. Payne, Sequential priming measures of implicit social cognition: a meta-analysis of associations with behavior and explicit attitudes, Personal. Soc. Psychol. Rev. 16 (4) (2012) 330–350.
[11] R.T. Cenfetelli, G. Bassellier, Interpretation of formative measurement in information systems research, MIS Q. 33 (4) (2009) 689–707.
[12] E. Chan, J. Sengupta, Insincere flattery actually works: a dual attitudes perspective, J. Mark. Res. 47 (1) (2010) 122–133.
[13] T. Chesney, An acceptance model for useful and fun information systems, Hum. Technol. Interdiscip. J. Hum. ICT Environ. 2 (2) (2006) 225–235.
[14] A.M. Collins, E.F. Loftus, A spreading-activation theory of semantic processing, Psychol. Rev. 82 (6) (1975) 407–428.
[15] M. Craeynest, G. Crombez, J. De Houwer, B. Deforche, A. Tanghe, I. De Bourdeaudhuij, Explicit and implicit attitudes towards food and physical activity in childhood obesity, Behav. Res. Ther. 43 (9) (2005) 1111–1120.
[16] M. Czyzewska, H.J. Ginsburg, Explicit and implicit effects of anti-marijuana and anti-tobacco TV advertisements, Addict. Behav. 32 (1) (2007) 114–127.
[17] F.D. Davis, R.P. Bagozzi, P.R. Warshaw, Extrinsic and intrinsic motivation to use computers in workplace, J. Appl. Soc. Psychol. 22 (14) (1992) 1111–1132.
[18] J. De Houwer, R. Custers, A. De Clercq, Do smokers have a negative implicit attitude toward smoking? Cogn. Emot. 20 (8) (2006) 1274–1284.
[19] P.G. Devine, P.S. Forscher, A.J. Austin, W.T. Cox, Long-term reduction in implicit race bias: a prejudice habit-breaking intervention, J. Exp. Soc. Psychol. 48 (6) (2012) 1267–1278.
[20] A.H. Eagly, S. Chaiken, The Psychology of Attitudes, Harcourt Brace Jovanovich College Publishers, Fort Worth, TX, 1993.
[21] B. Egloff, S.C. Schmukle, Predictive validity of an Implicit Association Test for assessing anxiety, J. Pers. Soc. Psychol. 83 (6) (2002) 1441–1455.
[22] L.L. Eldridge, D. Masterman, B.J. Knowlton, Intact implicit habit learning in Alzheimer's disease, Behav. Neurosci. 116 (4) (2002) 722–726.
[23] J.S.B.T. Evans, K.E. Stanovich, Dual-process theories of higher cognition: advancing the debate, Perspect. Psychol. Sci. 8 (3) (2013) 223–241.
[24] L.R. Fabrigar, T.K. MacDonald, D.T. Wegener, The structure of attitudes, in: D. Albarracín, B.T. Johnson, M.P. Zann (Eds.), The Handbook of Attitudes, Routledge, New York, 2005, pp. 79–124.
[25] C.M. Falbe, G. Yukl, Consequences for managers of using single influence tactics and combinations of tactics, Acad. Manag. J. 35 (3) (1992) 638–652.
[26] R.H. Fazio, Multiple processes by which attitudes guide behavior: the MODE model as an integrative framework, in: M.P. Zanna (Ed.), Advances in Experimental Social Psychology, Academic Press, San Diego, California, 1990, pp. 75–109.
[27] R.H. Fazio, M.A. Olson, Implicit measures in social cognition research: their meaning and use, Annu. Rev. Psychol. 54 (1) (2003) 297–327.
[28] M. Fishbein, A consideration of beliefs, and their role in attitude measurement, in: M. Fishbein (Ed.), Readings in Attitude Theory and Measurement, Wiley, New York, 1967, pp. 257–266.
[29] S.T. Fiske, S.E. Taylor, Social Cognition, Longman Higher Education, London, 1984.
[30] A.R. French, T.M. Franz, L.L. Phelan, B.E. Blaine, Reducing Muslim/Arab stereotypes through evaluative conditioning, J. Soc. Psychol. 153 (1) (2013) 6–9.
[31] M. Friese, M. Bluemke, M. Wanke, Predicting voting behavior with implicit attitude measures - the 2002 German parliamentary election, Exp. Psychol. 54 (4) (2007) 247–255.
[32] B. Gardner, A review and analysis of the use of 'habit' in understanding, predicting and influencing health-related behaviour, Health Psychol. Rev. 9 (3) (2015) 277–295.
[33] B. Gawronski, G.V. Bodenhausen, Associative and propositional processes in evaluation: an integrative review of implicit and explicit attitude change, Psychol. Bull. 132 (5) (2006) 692–731.
[34] B. Gawronski, F. Strack, On the propositional nature of cognitive consistency: dissonance changes explicit, but not implicit attitudes, J. Exp. Soc. Psychol. 40 (4) (2004) 535–542.
[35] A.G. Greenwald, M.R. Banaji, Implicit social cognition: attitudes, self-esteem, and stereotypes, Psychol. Rev. 102 (1) (1995) 4–27.
[36] A.G. Greenwald, M.R. Banaji, L.A. Rudman, S.D. Farnham, B.A. Nosek, D.S. Mellott, A unified theory of implicit attitudes, stereotypes, self-esteem, and self-concept, Psychol. Rev. 109 (1) (2002) 3–25.
[37] A.G. Greenwald, D.E. McGhee, J.L.K. Schwartz, Measuring individual differences in implicit cognition: the implicit association test, J. Pers. Soc. Psychol. 74 (6) (1998) 1464–1480.
[38] A.G. Greenwald, B.A. Nosek, M.R. Banaji, Understanding and using the implicit association test: I. An improved scoring algorithm, J. Pers. Soc. Psychol. 85 (2) (2003) 197–216.
[39] A.G. Greenwald, T.A. Poehlman, E.L. Uhlmann, M.R. Banaji, Understanding and using the implicit association test: III. Meta-analysis of predictive validity, J. Pers. Soc. Psychol. 97 (1) (2009) 17–41.
[40] J. Haidt, The emotional dog and its rational tail: a social intuitionist approach to moral judgment, Psychol. Rev. 108 (4) (2001) 814–834.
[41] T.K. Hartman, A.J. Newmark, Motivated reasoning, political sophistication, and associations between president Obama and Islam, Polit. Sci. Polit. 45 (3) (2012) 449–455.
[42] D.R. Hekman, K. Aquino, B.P. Owens, T.R. Mitchell, P. Schilpzand, K. Leavitt, An examination of whether and how racial and gender biases influence customer satisfaction, Acad. Manag. J. 53 (2) (2010) 238–264.
[43] Y.J. Kim, J.U. Chun, J. Song, Investigating the role of attitude in technology acceptance from an attitude strength perspective, Int. J. Inf. Manage. 29 (1) (2009) 67–77.
[44] S.J. Kraus, Attitudes and the prediction of behavior: a metaanalysis of empirical literature, Pers. Soc. Psychol. Bull. 21 (1) (1995) 58–75.
[45] K. Leavitt, C.T. Fong, A.G. Greenwald, Asking about well-being gets you half an answer: intra-individual processes of implicit and explicit job attitudes, J. Organ. Behav. 32 (4) (2011) 672–687.
[46] P. Legris, J. Ingham, P. Collerette, Why do people use information technology? A critical review of the technology acceptance model, Inf. Manag. 40 (3) (2003) 191–204.
[47] N. Lemon, Attitudes and Their Measurement, Wiley, New York, 1973.
[48] M. Limayem, C.M.K. Cheung, Understanding information systems continuance: the case of Internet-based learning technologies, Inf. Manag. 45 (4) (2008) 227–232.
[49] M. Limayem, S.G. Hirt, C.M.K. Cheung, How habit limits the predictive power of intention: the case of information systems continuance, MIS Q. 31 (4) (2007) 705–737.
[50] D. Maison, A.G. Greenwald, R. Bruin, The Implicit Association Test as a measure of implicit consumer attitudes, Polish Psychol. Bull. 32 (1) (2001) 1–9.
[51] N. Marquardt, R. Hoeger, The effect of implicit moral attitudes on managerial decision-making: an implicit social cognition approach, J. Bus. Ethics 85 (2) (2009) 157–171.
[52] W.J. McGuire, The structure of individual attitudes and attitude systems, in: A.R. Pratkanis, S.J. Breckler, A.G. Greenwald (Eds.), Attitude Structure and Function, Psychology Press, New York, 1989, pp. 37–69.
[53] A.W. Meade, FreeIAT: an open-source program to administer the implicit association test, Appl. Psychol. Meas. 33 (8) (2009) 643.
[54] B.A. Nosek, A.G. Greenwald, M.R. Banaji, Understanding and using the implicit association test: II. Method variables and construct validity, Personal. Soc. Psychol. Bull. 31 (2) (2005) 166–180.
[55] M.A. Olson, R.H. Fazio, Implicit and explicit measures of attitudes: the perspective of the MODE model, in: R.E. Petty, R.H. Fazio, P. Briñol (Eds.), Attitudes: Insights from the New Implicit Measures, Psychology Press, New York, NY, 2009, pp. 19–63.
[56] A.N. Oppenheim, Questionnaire Design and Attitude Measurement, Heinemann Educational Books, (1966) London.
[57] S. Orbell, B. Verplanken, The automatic component of habit in health behavior: habit as cue-contingent automaticity, Health Psychol. 29 (4) (2010) 374–383.
[58] M. Perugini, Predictive models of implicit and explicit attitudes, Br. J. Soc. Psychol. 44 (1) (2005) 29–45.

[59] W.M. Reynolds, Development of reliable and valid short forms of the Marlowe-Crowne social desirability scale, J. Clin. Psychol. 38 (1) (1982) 119–125.
[60] M.D. Robinson, B.P. Meier, K.J. Zetocha, K.D. McCaul, Smoking and the Implicit Association Test: when the contrast category determines the theoretical conclusions, Basic Appl. Soc. Psych. 27 (3) (2005) 201–212.
[61] L.A. Rudman, Sources of implicit attitudes, Curr. Dir. Psychol. Sci. 13 (2) (2004) 79–82.
[62] L.A. Rudman, J.E. Phelan, J.B. Heppen, Developmental sources of implicit attitudes, Pers. Soc. Psychol. Bull. 33 (12) (2007) 1700–1713.
[63] R.J. Rydell, A.R. McConnell, Understanding implicit and explicit attitude change: a systems of reasoning analysis, J. Pers. Soc. Psychol. 91 (6) (2006) 995–1008.
[64] R.J. Rydell, A.R. McConnell, D.M. Mackie, Consequences of discrepant explicit and implicit attitudes: cognitive dissonance and increased information processing, J. Exp. Soc. Psychol. 44 (6) (2008) 1526–1532.
[65] R.J. Rydell, A.R. McConnell, D.M. Mackie, L.M. Strain, Of two minds: forming and changing valence-inconsistent implicit and explicit attitudes, Psychol. Sci. 17 (11) (2006) 954–958.
[66] J.K. Sakaluk, R.R. Milhausen, Factors influencing university students' explicit and implicit sexual double standards, J. Sex Res. 49 (5) (2012) 464–476.
[67] F. Sartor, L.F. Donaldson, D.A. Markland, H. Loveday, M.J. Jackson, H.P. Kubis, Taste perception and implicit attitude toward sweet index and soft drink supplementation, Appetite 57 (1) (2011) 237–246.
[68] J. Schepers, M. Wetzels, A meta-analysis of the technology acceptance model: investigating subjective norm and moderation effects, Inf. Manag. 44 (1) (2007) 90–103.
[69] E.R. Smith, What do connectionism and social psychology offer each other? J. Pers. Soc. Psychol. 70 (5) (1996) 893–912.
[70] E.R. Smith, J. DeCoster, Associative and rule-based processes: a connectionist interpretation of dual-process models, in: S. Chaiken, Y. Trope (Eds.), Dual-Process Theories in Social Psychology, The Guilford Press, New York, 1999, pp. 323–336.
[71] E.R. Smith, J. DeCoster, Dual-process models in social and cognitive psychology: conceptual integration and links to underlying memory systems, Personal. Soc. Psychol. Rev. 4 (2) (2000) 108–131.
[72] D. Stanley, E. Phelps, M. Banaji, The neural basis of implicit attitudes, Curr. Dir. Psychol. Sci. 17 (2) (2008) 164–170.
[73] F. Strack, R. Deutsch, The reflective-repulsive model, in: J.W. Sherman, B. Gawronski, Y. Trope (Eds.), Dual-Process Theories of the Social Mind, The Guilford Press, New York, 2014, pp. 93–104.
[74] H. Sun, P. Zhang, The role of moderating factors in user technology acceptance, Int. J. Hum. Stud. 64 (2) (2006) 53–78.
[75] O. Turel, A. Bechara, Social Networking Site use while driving: ADHD and the mediating roles of stress, self-esteem and craving, Front. Psychol. 7 (2016) 1–10 (Article 455).
[76] O. Turel, A. Bechara, A triadic reflective-impulsive-interoceptive awareness model of general and impulsive information system use: behavioral tests of neuro-cognitive theory, Front. Psychol. 7 (2016) 1–11 (Article 601).
[77] O. Turel, Q. He, G. Xue, L. Xiao, A. Bechara, Examination of neural systems subserving Facebook "addiction", Psychol. Rep. 115 (3) (2014) 675–695.
[78] O. Turel, H. Qahri-Saremi, Problematic use of social networking sites: antecedents and consequence from a dual system theory perspective, J. Manag. Inf. Syst. 33 (4) (2016) 1087–1116.
[79] O. Turel, A. Serenko, The benefits and dangers of enjoyment with social networking websites, Eur. J. Inf. Syst. 21 (5) (2012) 512–528.
[80] O. Turel, A. Serenko, N. Bontis, User acceptance of wireless short messaging services: deconstructing perceived value, Inf. Manag. 44 (1) (2007) 63–73.
[81] O. Turel, A. Serenko, P. Giles, Integrating technology addiction and use: an empirical investigation of online auction sites, MIS Q. 35 (4) (2011) 1043–1061.
[82] H. van der Heijden, User acceptance of hedonic information systems, MIS Q. 28 (4) (2004) 695–704.
[83] M.W. Vasey, C.N. Harbaugh, A.G. Buffington, C.R. Jones, R.H. Fazio, Predicting return of fear following exposure therapy with an implicit measure of attitudes, Behav. Res. Ther. 50 (12) (2012) 767–774.
[84] B. Verplanken, Habit: from overt action to mental events, in: C.R. Agnew, D.E. Carlston, W.G. Graziano, J.R. Kelly (Eds.), Then a Miracle Occurs: Focusing on Behavior in Social Psychological Theory and Research, Oxford University Press, NY, 2009, pp. 68–88.
[85] B. Verplanken, O. Friborg, C.E. Wang, D. Trafimow, K. Woolf, Mental habits: metacognitive reflection on negative self-thinking, J. Pers. Soc. Psychol. 92 (3) (2007) 526–541.
[86] B. Verplanken, V. Myrbakk, E. Rudi, The measurement of habit, in: T. Betsch, S. Haberstroh (Eds.), The Routines of Decision Making, Lawrence Erlbaum Associates, New York, 2005, pp. 231–247.
[87] R. West, The psychology of security, Commun. ACM 51 (4) (2008) 34–40.
[88] T.D. Wilson, S. Lindsey, T.Y. Schooler, A model of dual attitudes, Psychol. Rev. 107 (1) (2000) 101–126.
[89] W. Wood, J.S. Labrecque, P.Y. Lin, D. Rünger, Habits in dual process models, in: J.W. Sherman, B. Gawronski, Y. Trope (Eds.), Dual-Process Theories of the Social Mind, The Guilford Press, New York, 2014, pp. 371–385.
[90] W. Wood, D.T. Neal, A new look at habits and the habit-goal interface, Psychol. Rev. 114 (4) (2007) 843–863.
[91] W. Wood, J.M. Quinn, D.A. Kashy, Habits in everyday life: thought, emotion, and action, J. Pers. Soc. Psychol. 83 (6) (2002) 1281–1297.
[92] N.A. Wright, A.W. Meade, An exploration of cognitive ability contamination in the Implicit Association Test methodology, Comput. Human Behav. 28 (2) (2012) 393–399.
[93] J.C. Ziegert, P.J. Hanges, Employment discrimination: the role of implicit attitudes, motivation, and a climate for racial bias, J. Appl. Psychol. 90 (3) (2005) 553–562.
[94] O. Turel, A. Serenko, N. Bontis, User acceptance of hedonic digital artifacts: a theory of consumption values perspective, Inform. Manag. 47 (2010) 53–59.
[95] A. Serenko, O. Turel, Integrating technology addiction and use: An empirical investigation of Facebook users, AIS Trans. Replic. Res. 1 (2015) 0–18.
[96] D.S. Soper, O. Turel, Theory in North American Information Systems Research: A Culturomic Analysis, Commun. Assoc. Inform. Syst. 38 (2016) 477–500.
[97] O. Turel, Quitting the use of a habituated hedonic information system: a theoretical model and empirical examination of Facebook users, Eur. J. Inform. Syst. 24 (2015) 431–446.
[98] O. Turel, Untangling the complex role of guilt in rational decisions to discontinue the use of a hedonic Information System, Eur. J. Inform. Syst. 25 (2016) 432–447.
[99] O. Turel, Organizational deviance via social networking site use: The roles of inhibition, stress and sex differences, Person. Indiv. Diff. 119 (2017) 311–316.
[100] O. Turel, A. Bechara, Effects of motor impulsivity and sleep quality on swearing, interpersonally deviant and disadvantageous behaviors on online social networking sites, Person. Indiv. Diff. 108 (2017) 91–97.
[101] O. Turel, D. Brevers, A. Bechara, Time distortion when users at-risk for social media addiction engage in non-social media tasks, J. Psychiatric Res. 97 (2018) 84–88.
[102] Q. He, O. Turel, A. Bechara, Brain anatomy alterations associated with Social Networking Site (SNS) addiction, Sci. Rep. 7 (2017) 1–8.
[103] Q. He, O. Turel, A. Bechara, Association of excessive social media use with abnormal white matter integrity of the corpus callosum, Psychiatry Res. Neuroimaging 278 (2018) 42–47.
[104] Q. He, O. Turel, D. Brevers, A. Bechara, Excess social media use in normal populations is associated with amygdala-striatal but not with prefrontal morphology, Psychiatry Res. Neuroimaging 269 (2017) 31–35.
[105] O. Turel, H. Qahri-Saremi, Explaining unplanned online media behaviors: Dual system theory models of impulsive use and swearing on social networking sites, New Media Soc. 20 (2018) 3050–3067.
[106] O. Turel, A. Romashkin, K.M. Morrison, Health Outcomes of Information System Use Lifestyles among Adolescents: Videogame Addiction, Sleep Curtailment and Cardio-Metabolic Deficiencies, PLoS One 11 (2016) e0154764.
[107] O. Turel, A. Romashkin, K.M. Morrison, A model linking video gaming, sleep quality, sweet drinks consumption and obesity among children and youth, Clin. Obesity 7 (2017) 191–198.
[108] L. Wei, S. Zhang, O. Turel, A. Bechara, Q. He, A Tripartite Neurocognitive Model of Internet Gaming Disorder, Front. Psychiatry 8 (2017) 1–11.
[109] B. Osatuyi, O. Turel, Tug of war between social self-regulation and habit: Explaining the experience of momentary social media addiction symptoms, Comput. Hum. Behav. 85 (2018) 95–105.
[110] O. Turel, M. Mouttapa, E. Donato, Preventing problematic Internet use through video-based interventions: a theoretical model and empirical test, Behav. Inform. Technol 34 (2015) 349–362.
[111] Z.C. Xu, O. Turel, Y.F. Yuan, Online game addiction among adolescents: motivation and prevention factors, Eur. J. Inform. Syst. 21 (2012) 321–340.
[112] M. Ghasemaghaei, K. Hassanein, O. Turel, Increasing firm agility through the use of data analytics: The role of fit, Decis. Supp. Syst. 101 (2017) 95–105.
[113] S. Farivar, O. Turel, Y. Yuan, Skewing users' rational risk considerations in social commerce: An empirical examination of the role of social identification, Inform. Manag. 55 (2018) 1038–1048.

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