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# Measuring Implicit Attitude in Information Systems Research with the Implicit Association Test

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**Abstract:**

Information systems (IS) research has primarily focused on explicit perceptions, attitudes, and intentions of which users are largely aware. We argue that this view may be too narrow. We extend it by presenting the concept of implicit attitude, which is as a stable subconscious evaluation of an IS that is developed a priori, stored in memory, and triggered with limited or no awareness and intentional effort when users are exposed to system-related stimuli. We further discuss the theoretical aspects of implicit attitude toward IS and document a set of guidelines regarding a technique for implicit attitude measurement: the implicit association test (IAT). We further present an overview of the *Free*IAT software package and offer a practical example and configuration of the IAT, which includes its administration and scoring. Overall, this tutorial builds methodological foundations for future inquiries into the role of implicit processes in IS research.

**Keywords:** Implicit Attitude, Implicit Association Test, Social Networking Sites, Instagram.

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# 1 Introduction

The human mind has been described as an iceberg with its tip above the water, representing explicit processes (e.g., traits, attitudes, and intentions of which users are largely aware), and the majority of ice below the surface, representing implicit and mostly subconscious processes (e.g., states, attitudes, and mental associations of which users are largely unaware) (Joseph, 1992). Numerous studies on human behavior have supported the validity of this view and the significance of subconscious processes (Greenwald, Poehlman, Uhlmann, & Banaji, 2009). The information systems (IS) literature has also emphasized the potential importance of such subconscious mental processes (Ortiz de Guinea & Markus, 2009; Ortiz de Guinea, Titah, & Léger, 2014). In this tutorial, we extend this line of inquiry by 1) describing the concept of implicit attitude (a stable subconscious evaluation of an IS) and 2) demonstrating a common way to measure it; namely, the implicit association test (IAT).

Implicit attitude is a stable subconscious evaluation of an IS that is developed a priori, stored in memory, and triggered with limited or no awareness and intentional effort when users are exposed to system-related stimuli. We need to be able to understand and measure IS users' implicit attitude for two reasons. First, the measurement of implicit attitude does not rely on self-reports, and, as a result, the measures of implicit attitude are less affected by individual biases, personal misinterpretations, or intentional deception (Schnabel, Asendorpf, & Greenwald, 2008). In the context of socially sensitive user states and use behaviors, such as cyberdeviance (Venkatraman, Cheung, Lee, Davis, & Venkatesh, 2018) and other socially unacceptable forms of use (Serenko & Turel, 2020a; Tarafdar, Gupta, & Turel, 2013), people may under- or over-report their true explicit attitude (Greenwald et al., 2009). Such reporting may bias models that rely on explicit attitude but should have no impact on the hypothesized effects of implicit attitude because users are typically unaware of their implicit attitude and, as a result, would find it difficult to introduce a deliberate bias during its measurement. Hence, focusing on implicit attitude can reduce inherent biases in system use models similar to how neuroIS tools can reduce several explicit measurement biases (Tams, Hill, de Guinea, Thatcher, & Grover, 2014).

Second, implicit attitude can help researchers understand how other subconscious states form, especially in the context of unplanned, impulsive, or automatic IS use (Turel & Bechara, 2016). Planned-behavior (Turel & Qahri-Saremi, 2016) and continued-use (Kim & Malhotra, 2005) IS models do not explain many IS-related behaviors well because they do not account for automatic user states and actions (Ortiz de Guinea & Webster, 2013). However, implicit attitude can influence various subconscious constructs through mechanisms that differ from those that conscious processes employ. For example, while explicit attitude (i.e., a conscious construct) influences behavior through the formation of behavioral intentions (Bhattacherjee, 2001), implicit attitude (i.e., a subconscious construct) can operate through two mechanisms: it can 1) directly trigger automatic behavioral responses without producing behavioral intentions (Belletier, Robert, Moták, & Izaute, 2018) and 2) facilitate the development of other subconscious states (Stacy & Wiers, 2010). For example, implicit attitude can promote the habituation of and even addiction to IT-related behaviors, both of which pertain to subconscious processes (Serenko & Turel, 2019; Turel & Serenko, 2020). Hence, understanding the role of implicit attitude in the context of IS may improve our understanding of various system- and user-related phenomena. Measuring implicit attitude does not require expensive brain-imaging techniques, and, as we demonstrate in this tutorial, many IS researchers may easily deploy it in their studies. Even though IS research has made progress in trying to understand the role of subconscious processes, it has insufficiently explored the role of implicit attitude and its impact on other subconscious constructs.

All subconscious processes develop and exist beyond users' awareness (Latham, Stajkovic, & Locke, 2010; Stajkovic, Locke, & Blair, 2006). They are automatically triggered when users are exposed to relevant external and internal stimuli and may lead to spontaneous behaviors and the development, change, or reinforcement of other subconscious processes (Wegmann, Müller, Turel, & Brand, 2020). As such, users remain completely unaware about the mechanisms that cultivate and activate their subconscious processes, do not realize what triggered a potential course of action or mental state, and cannot control their implicit attitude. As a result, implicit attitude is below awareness levels and cannot be simply self-reported. Therefore, a noteworthy challenge in accounting for implicit attitude concerns its measurement. Explicit attitude is measured by directly soliciting responses from system users via surveys or interviews. In contrast, implicit attitude can only be measured indirectly because it is beyond user awareness and cannot be subjected to retrospective evaluation. NeuroIS research has provided various implicit measures (Dimoka et al., 2012; Dimoka, Pavlou, & Davis, 2011; Minas et al., 2019; Riedl et al., 2010a; Tams et al., 2014), but many IS researchers may not be able to access neuroIS tools, and using

such tools requires a tremendous degree of expertise. Thus, while neuroIS tools add much value to the IS discipline, we believe that other means for capturing implicit processes may help researchers better understand IS users' decisions, states, and behaviors. In this tutorial, we describe in detail how to use the IAT (Greenwald, McGhee, & Schwartz, 1998), a well-established, simple technique for capturing implicit attitude that has proven to have good predictive validity across contexts (Greenwald et al., 2009). Therefore, we help scholars understand, measure, and apply implicit attitude in IS research in order to easily tap into this important subconscious concept that exists in IS users' minds, without the use of neuroIS tools, as a means to supplement neuroIS findings.

This tutorial proceeds as follows: in Section 2, we introduce and elaborate on the concept of implicit attitude. In Section 3, we offer a historical overview of implicit measures. In Section 4, we explain the IAT in detail, which includes its measures, constructs, attributes, stimuli, design, administration, theoretical foundations, scoring, and limitations. In Section 5, we demonstrate the IAT design via the *Free*IAT software package. Finally, in Section 6, we conclude the paper.

## 2 Implicit Attitude

Attitude refers to a psychological evaluation of an object, a person, or a concept with some degree of favor or disfavor (Eagly & Chaiken, 1993). A vast majority of previous IS studies have focused on users' explicit attitude and assumed that people are fully aware of their attitude and may accurately self-report it during surveys or interviews. However, individuals also possess implicit attitude, and it can independently influence behaviors and subconscious processes and states of mind (Fazio & Olson, 2003; Greenwald et al., 2002; Greenwald et al., 2009; Rydell, McConnell, & Mackie, 2008; Rydell, McConnell, Mackie, & Strain, 2006; Wilson, Lindsey, & Schooler, 2000).

The simultaneous existence and impacts of both conscious and subconscious processes have received some attention in IS research (Park, Keil, Bock, & Kim, 2016; Serenko & Turel, 2016; Soror, Hammer, Steelman, Davis, & Limayem, 2015; Turel & Qahri-Saremi, 2018). These efforts have relied on dual system theories, all of which suggest that people have two information processing systems: intuition based (which functions automatically, quickly, effortlessly, uncontrollably, and associatively) and reasoning based (which is deliberate, slow, and rule-governed) (Kahneman, 2003). Examples include the elaboration likelihood model (Petty & Cacioppo, 1986) and the heuristic-systematic model of information processing (Chaiken, 1980; Chaiken, Liberman, & Eagly, 1989). The dual system perspective has also received neuroscientific support through studies that show the existence and relevance of such systems for social media (He, Turel, & Bechara, 2017a, 2018; He, Turel, Brevers, & Bechara, 2017b; Turel, He, Brevers, & Bechara, 2018; Turel, He, Xue, Xiao, & Bechara, 2014) and video game (Turel, He, Wei, & Bechara, 2020) users. Whereas these theories, neural models, and their application in IS research do not directly focus on attitude and its measures (e.g., see Puhakainen & Siponen, 2010), they indirectly hint at the possibility that implicit attitude exists and influences behaviors and states of mind. They also largely point to the nature of each type of attitude – elaborated, effortful, and slow (i.e., explicit) versus impulsive, effortless, and automatic (i.e., implicit).

The model of dual attitudes treats explicit and implicit attitudes in a more formal manner (Wilson et al., 2000). It specifically explains the existence, formation, and consequences of explicit and implicit attitudes toward the same object. This model has become the *de facto* standard in explaining explicit and implicit attitudes and processes (Ajzen, 2001; Dovidio, Kawakami, & Gaertner, 2002; Evans, 2008; Gawronski & Bodenhausen, 2006; Greenwald et al., 2002). It posits that people are aware of their explicit attitude; they access a set of system-relevant beliefs in their memory, consciously summarize them, construct the most appropriate attitude in the current context, and report it to the researcher. In contrast, implicit attitude is subconscious—it is developed a priori, is stored in the user's subconscious memory, exists beyond the user's awareness, and is automatically activated when the user is exposed to a system-related stimulus (i.e., a cue, see Chen et al., 2018). Whereas both attitudes can drive user behavior, they operate differently (Fazio & Olson, 2003; Rydell et al., 2006). In the IS context, explicit attitude is involved in goal-directed action and consequently drives behavioral intentions, which in turn influence system use. In contrast, implicit attitude is invoked automatically and typically is not associated with explicit goals. In the IS context, it has two unique impacts. First, because implicit attitude exists beyond a user's awareness, it directly affects system use and bypasses behavioral intentions (Belletier et al., 2018). Second, it directly influences other subconscious mental processes and states, including habit (Serenko & Turel, 2019) and addiction (Turel & Serenko, 2020).

Elaborating on this distinction, we note that explicit and implicit attitudes fundamentally differ along several dimensions (see Table 1) (Greenwald et al., 1998). First, while explicit attitude forms quickly through direct interaction with a system (e.g., during a brief use session), the development of implicit attitude is usually a long-term process; it is developed through repeated subconscious pairings between an attitude object and related evaluations during long-term system use (Greenwald et al., 2009; Rydell & McConnell, 2006). Second, whereas the formation of explicit attitude always requires direct exposure to the attitude object, implicit attitude may be developed not only through direct interaction with a system but also during extensive passive socialization, reading, deliberate thinking, and observations of others (Rudman, 2004; Rudman, Phelan, & Heppen, 2007). Third, explicit attitude can change quickly because users may simply alter their overt beliefs about a system under the influence of external factors (e.g., sequential updating processes (Kim, 2009)). In contrast, implicit attitude takes a long time to change and it is relatively context-independent (Rydell & McConnell, 2006). Fourth, users may control their explicit attitude because they are fully aware of it (e.g., suppress socially undesirable attitudes). Implicit attitude, however, exists beyond people's conscious awareness and cannot be easily manipulated. Fifth, explicit attitude requires deliberate memory access and the consumption of mental resources, which are not always available. In contrast, implicit attitude is generated automatically, and it consumes little mental resources.

Sixth, implicit attitude is typically automatically triggered first, and it may or may not be followed by the construction of explicit attitude to guide behavior (Olson & Fazio, 2009). Hence, in some situations, people behave solely based on their implicit attitude, without developing intentions to act (Dijksterhuis & Bargh, 2001). Because people routinely use various highly-familiar IS, such as social networking sites (SNS), search engines, and email applications, they can at least sometimes do so automatically without engaging in conscious cognitive processing of system-relevant beliefs (Serenko & Turel, 2019; Turel & Bechara, 2016). When being exposed to a system-related stimulus (e.g., a new message notification), implicit attitude is automatically activated, which, in turn, may determine behavior (e.g., checking the newly arrived email message without thinking). Implicit attitude is always automatically invoked first before the user constructs or retrieves explicit attitude. As a result, system-directed behavior may be determined by implicit attitude only or by a combination of implicit and explicit attitudes, depending on the user's *motivation* and *opportunity* to consciously develop explicit attitude (Olson & Fazio, 2009). Seventh, explicit attitude has an effect on various conscious processes – particularly, on behavioral intentions. In contrast, implicit attitude directly affects a user's behavior and never triggers behavioral intentions (Belletier et al., 2018). In addition, implicit attitude impacts other subconscious mental processes and states.

**Table 1. Implicit Attitude vs. Explicit Attitude**

| Factor | Implicit attitude | Explicit attitude |
|---|---|---|
| Development speed | Slow | Fast |
| Direct system experience | Not required | Required |
| Speed of change | Slow | Fast |
| Control | Almost impossible | Possible |
| Deliberate memory access | Not required | Required |
| Activation sequence | First | Second |
| Impact on | Behavior and subconscious processes and states | Behavioral intentions and conscious processes |

Recently, the IS literature has started tapping into implicit processes (Belletier et al., 2018; Gong, 2008; Kaye & Pennington, 2016; Lannoy et al., 2020; Serenko & Turel, 2019; Subramanian, Wise, Davis, Bhandari, & Morris, 2014; Turel & Serenko, 2020; Wei & Liu, 2020). For example, Ortiz de Guinea et al. (2014) demonstrated that implicit (memory load and distraction) and explicit (engagement and frustration) neuropsychological states act as antecedents of perceived usefulness and perceived ease of use, respectively. Clark, Robert, and Hampton (2016) showed that people have developed a tendency to implicitly associate technology with success. Serenko and Turel (2020b) measured implicit gender identity in order to predict gender-based differences in IT career choices. Weinert, Maier, and Laumer (2015) proposed a theoretical model that explains intentions via joint implicit-explicit attitude effects. However, to understand the basic principles of implicit attitude and measure it through the IAT, researchers have to rely on multiple sources from reference disciplines—mostly from psychology. No previous IS study has documented the use of the IAT in such a detail as to allow a busy IS researcher to quickly comprehend

and be able to use this measurement technique. Thus, IS scholars may benefit from a comprehensive theoretical and methodological overview of the IAT that we present in this tutorial.

# 3 A Historical Overview of Implicit Measures

Psychologists have been always fascinated with the idea of tapping into the hidden dimensions of the human mind (Rudman, 2011). As a result, they have developed various implicit measures which may be classified into four broad categories: accessibility based, interpretation based, neuropsychological based, and association based (Stanley, Phelps, & Banaji, 2008; Uhlmann et al., 2012). Accessibility-based measures estimate the degree to which the target concept is activated and is accessible in a person's mind. The key assumption is that highly accessible implicit concepts make individuals more likely to recognize related stimuli that determine how they respond to their environment. Measures include the lexical decision task (Meyer & Schvaneveldt, 1971), the word fragment completion test (Tulving, Schacter, & Stark, 1982), and the Stroop task (Stroop, 1935). Interpretation-based measures rest on the assumption that when people are presented with ambiguous stimuli, such as images, phrases, or scenarios that are open to interpretation, they automatically invoke their chronically accessible needs, beliefs, attitudes, and motivations when trying to explain the phenomenon they are dealing with. Common approaches include the Rorschach inkblot test (Rorschach, 1942), the thematic apperception test (Murray, 1951), and the Miner sentence completion scale (Miner, 1978). Neuropsychological-based measures (Ortiz de Guinea et al., 2014; Stanley et al., 2008) use specialized methods and tools, such as functional magnetic resonance imaging (fMRI), electroencephalography (EEG), skin conductance tests, and pupil dilation readings to capture neural correlates of phenomena of interest. Recent neuroIS studies (Dimoka, 2010; Dimoka et al., 2012, 2011; Riedl, 2013; Riedl et al., 2010a; Riedl, Davis, & Hevner, 2014; Riedl, Hubert, & Kenning, 2010b; Riedl, Kindermann, Auinger, & Javor, 2012; Tams et al., 2014; Warkentin, Walden, Johnston, & Straub, 2016) have proposed ways to measure (often subconscious) bio-physiological processes (e.g., people are not aware of their neuronal activity). Hence, the measurement of implicit attitude and neuroIS share the feature of tapping into subconscious processes.

Despite the scientific merit of the measures above, they have several limitations. Accessibility-based approaches often exhibit poor reliability. For example, the Stroop task produces unacceptably low test-retest reliability scores under certain conditions (Strauss, Allen, Jorgensen, & Cramer, 2005). Interpretation-based measures suffer from inter-rater reliability issues, predictive validity problems, and rater biases (Garb, 1999). Whereas neuropsychological-based measures are generally considered reliable and valid, they can have limitations in relation to spatial resolution, reach to subcortical areas, and so on (Lobello, Morgenlander, Radtke, & Bushnell, 2006; Pandit & Cook, 2013), and their administration requires access to expensive equipment and a high degree of expertise. They can, nevertheless, be used for capturing subconscious processes in IS users' minds. However, prior neuroIS research has not focused on attitude and implicit attitude. Neuroscience paradigms can potentially bridge the gap between brain activation and implicit attitude (Ames et al., 2014, 2013), but the neuroIS research stream has yet to take this route. Hence, we see the IAT as a separate tool that can inform research beyond or in addition to the existing measures, including neuroIS, and it can also be potentially integrated with neuroIS studies, in a manner similar to those in which current neuroIS studies are used to measure correlates with explicit processes.

Association-based measures, which assess the magnitude of the implicit links between the target construct and its attribute in the subject's memory, address most of the shortcomings above. They allow researchers to tap into the attributes (e.g., gender: man vs. woman) associated with a target construct (e.g., an IT employee). A strong association between the attribute "man" and the construct "IT employee" implies that the subject associates IT professionals with men. Association-based tests generally rely on subjects' reaction times and accuracy when they sort construct- and attribute-related stimuli into categories.

Initially, Fazio and colleagues introduced the *evaluative priming* techniques (Fazio, Chen, McDonel, & Sherman, 1982; Fazio, Powell, & Herr, 1983), which were later extended as the affective priming test (Fazio, Jackson, Dunton, & Williams, 1995; Hermans, De Houwer, & Eelen, 1994), the semantic priming task (Wittenbrink, Judd, & Park, 1997), and the affective Simon paradigm (De Houwer & Eelen, 1998). Despite the recognition and widespread use of evaluative priming as a predictor of human behavior, this approach has several limitations (Rudman, 2011; Wittenbrink, 2012). First, designing, implementing, and administering priming procedures constitute complex endeavors that require technical expertise. Second, administering priming tasks consumes a lot of time because the process needs to be closely monitored to

avoid the confounding effects of other variables. Third, evaluative priming tests produce outcomes that are highly sensitive to the type of objects used as primes. Last, the technique exhibits low internal consistency and produces small effect sizes. Therefore, researchers needed another methodological approach to measure implicit attitude.

Based on their review of previous memory research, Greenwald and Banaji (1995) coined the term *implicit social cognition* and called for the introduction of its measures. Greenwald et al. (1998) extended this idea and introduced the IAT, which addressed most of the limitations associated with the evaluative priming technique (Greenwald et al., 2009). Due to its simplicity and accessibility to most researchers, the IAT has become the most well-known approach for measuring implicit attitude in psychology (De Houwer & Moors, 2010, 2012; Fazio & Olson, 2003). In general, the IAT and evaluating priming techniques produce consistent results (Cunningham, Preacher, & Banaji, 2001). Consequently, the IAT has already received attention in management research (Brunel, Tietje, & Greenwald, 2004; Dimofte, 2010; Hekman et al., 2010; Trendel, Mazodier, & Vohs, 2018; Ziegert & Hanges, 2005). One of the most frequent applications of the IAT is the measurement of implicit attitude toward an object, a person, or a concept. In particular, the IAT may be effectively and efficiently applied to measure implicit attitude toward an IT artifact.

# 4 The Implicit Association Test

## 4.1 An Overview

The IAT is a computer-based test that asks subjects to sort words (i.e., stimuli) into categories by pressing the “E” (left) or “I” (right) key. The stimuli appear in the center of the screen one at a time, and the target construct (Instagram), the non-target construct (MS Excel), and the attribute (Enjoyment) are located in the top left and right corners. Figure 1 presents the IAT design to measure implicit attitude toward Instagram. We use Instagram throughout this tutorial as the target system. We selected Microsoft (MS) Excel as the non-target (contrast) construct that the IAT administration requires as we explain below in detail.

Presently, the most common IAT design includes five blocks. The initial IAT design included seven blocks, but it failed to provide additional benefits, and researchers generally accept a five-block design as the current IAT standard (Nosek, 2005). In addition, using fewer blocks reduces cognitive load on subjects and improves test accuracy. Blocks 1, 2, and 4 (which comprise 20 trials each) are only for practice, but the subjects should be unaware of this. Blocks 3 and 5 comprise 40 trials each where the target construct and the non-target construct are combined with an attribute. The strength of the measured attitude depends on the subject’s difference in performance (speed and accuracy) in Block 5 (where the target construct and the attribute are incongruent) and in Block 3 (where the target construct and the attribute are congruent).

## 4.2 Constructs, Attributes, and Stimuli Selection

The IAT measures the magnitude of the differential association of two target concepts with an attribute. The administration of the IAT requires the selection of two constructs (the target construct and the non-target construct), one attribute, and a set of stimuli. The process of IAT development comprises five steps.

### 4.2.1 Step 1: Identify the Target Construct

The target construct refers to the focal construct toward which implicit attitude is measured. It may be an object (e.g., an IT artifact), a person (e.g., an IT expert), an action (e.g., hacking), or a concept (e.g., copyright). If needed, researchers should provide subjects with the construct’s definition and examples in the study’s context.

To demonstrate how to apply the IAT and explain its theoretical underpinnings, we designed the IAT to measure the degree of implicit attitude toward Instagram (i.e., an IS object). In this case, Instagram is referred to as the target construct which must be contrasted with another (i.e., non-target) construct, also referred to as the contrast construct, based on an attribute of interest.

### 4.2.2 Step 2: Select the Attribute

This step specifies the type of a measured attitude. The attribute should perfectly reflect the target construct’s most salient characteristic and quality. Ideally, it should match the type of attitude that

automatically (without conscious effort) comes to mind when one hears the name of the target construct. Examples of the target construct–attribute pairs include video games–enjoyment (enjoyable/unenjoyable); spyware–harm (bad/good); and BitTorrent–legality (legal/illegal). Selecting an incorrect type of attitude (e.g., computer virus–visual appeal) produces mentally incongruent categories and gives no useful results. However, note that, in some cases, there may be several types of attitudes of somewhat similar magnitude that may work well with the same target construct. For instance, when an IT manager (i.e., a person) is selected as a target construct, attributes may pertain to the manager's personal characteristics, such as honesty (honest/dishonest), expertise (experienced/inexperienced), kindness (kind/unkind), and so on. Thus, when researchers decide on the attribute, they need to consider both its fit with the target construct and the purpose of the study. We also recommend determining the most common context of use and/or characteristics of the target construct to ensure that it is properly aligned with the proposed attribute. We theoretically review the dimensionality of attributes in the IAT context in Appendix A. Researchers should do formal/informal interviews, experiments, and/or focus groups to select attributes and pilot-test all choices.

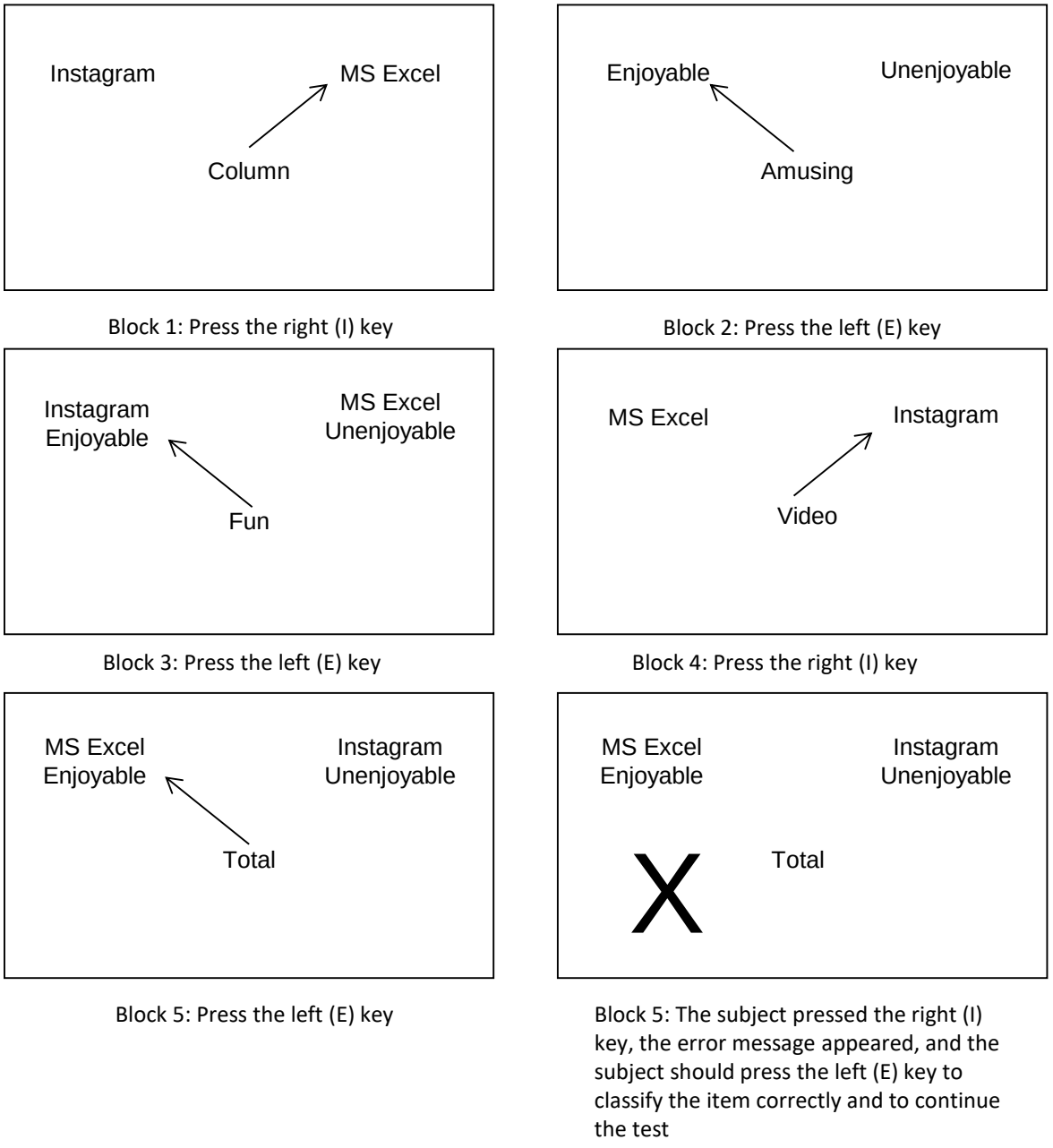


**Figure 1. The IAT (Implicit Attitude toward Instagram)**

In this tutorial, we use enjoyment (enjoyable/unenjoyable) as the attribute of interest because we presume hedonic rewards to be the key elements of the cue-reward-behavior associations that people build and that manifest their implicit attitude. Because enjoyment constitutes an extremely salient dimension of overall attitude toward Instagram, it makes the attitude construct virtually unidimensional (as we describe in Appendix A).

### 4.2.3 Step 3: Select the Non-target (contrast) Construct

The non-target (contrast) construct is used as a contrasting category against which the attitude toward the target construct is measured. It may be an object, a person, an action, or a concept, and it must match the type of the target construct. For instance, to measure attitude toward self (a person), the non-target construct may be others (people) but not an object (a car).

The IAT score is based on the difference in implicit attitude between the target construct and the non-target construct. For example, if the target construct is Instagram and the non-target construct is Twitter, the resulting IAT score is the difference between the attitude toward Instagram and that toward Twitter (based on the selected attribute, such as enjoyment). To measure only the attitude toward the target construct, the non-target construct must be neutral in valence with respect to the selected attribute. For example, if MS Excel is selected as a non-target construct instead of Twitter (most people do not associate MS Excel with enjoyment), there will be little variance in attitude toward MS Excel, and the resulting scores would reflect the variance in attitude toward Instagram. The neutrality (based on the selected attribute) of the non-target construct may be justified theoretically (e.g., by analyzing the common features of the IT artifact) and/or empirically (e.g., through informal/formal discussions, interviews, or surveys of those familiar with it).

In our hypothetical study, we assume that one wants to use the IAT to measure the degree of implicit attitude toward Instagram rather than a difference between implicit attitudes toward two different SNS. Thus, to maximize the validity of the IAT scores, the non-target construct should not be particularly valenced[1]; instead, it should be neutral for most people (Robinson, Meier, Zrtocha, & McCaul, 2005). If, for instance, attitude toward Instagram (which is generally expected to be positive with some variance) is compared to that toward YouTube (which is also generally expected to be positive with some variance), the IAT measure may be confounded by the varying positive attitude toward YouTube (the non-target construct).

For this reason, we employed MS Excel as a non-target (i.e., contrast) construct. From a theoretical viewpoint, based on the Chesney (2006) scale for the classification of information systems along the fun and productivity dimensions, MS Excel scores low on fun and high on productivity. Its use is driven primarily by utilitarian (i.e., non-hedonic) features (Chau, 1996). We confirmed this view empirically through informal interviews with 20 MS Excel users; they acknowledged that they use it only to accomplish a particular task and to enhance their productivity. They mentioned no hedonic factors. When questioned whether they found using it enjoyable or unenjoyable, they reported a neutral attitude. In fact, most had neither positive nor negative valence toward the system; they saw it merely as a productivity tool. Thus, we assumed that MS Excel represents a good non-target category in the context of the selected enjoyment attribute. Whereas Weinert et al. (2015) recommended the use of SAP as a contrast category for administering the IAT in the SNS context, we posit that MS Excel is more relevant because not all subjects may be aware of SAP and few, if any, have had direct experience with it. Nevertheless, future researchers may look into the use of other IT artifacts as a contrast category in other IS environments.

### 4.2.4 Step 4: Ensure Equal Visual or Semantic Processing of the Constructs

During the IAT, the target and non-target constructs may be presented as images or words. The key purpose is to ensure that the amount of cognitive resources required to process each construct is approximately equal. Images should be similar in size, and text should contain approximately the same number of words or have a somewhat similar length. For instance, Facebook Video Calling (the target construct) versus Skype (the non-target construct) represents a bad combination because the former is much longer than the latter; it can be adjusted as FB Video vs. Skype for better results. In this case, a definition and screenshots of FB Video and Skype should be provided to avoid ambiguity. Discord versus

[1] Valence refers to the intrinsic attractiveness or averseness of an attitude object and may be interpreted as a sign (positive or negative) of implicit attitude in the context of a selected attitudinal dimension.

Skype represents another good example. In the present example, we believe that Instagram (9 characters) versus MS Excel (8 characters with the space) represents an acceptable combination.

### 4.2.5 Step 5: Select Representative Words

For the target construct, the non-target construct, and the attribute, a minimum of five stimuli (representative words) must be selected. The stimuli should be short, simple, well-known, and easy to visually recognize. For the attribute, existing measurement scales may be consulted to identify the most commonly used representative keywords. The following steps are recommended. First, equality of semantic processing must be ensured by keeping the number of characters in the words approximately equal. Note that for the attribute, stimuli with two opposite valences must be selected. Second, the fit of the construct/attribute–stimuli must be empirically confirmed through formal/informal interviews, experiments, and/or focus groups with potential subjects. For instance, individuals may be presented with a randomized list of potential words, asked to sort them into two categories, and questioned about their experience (e.g., whether they encountered any difficulty, had to think hard, were unsure, etc.) Appendix B presents a draft instrument that may be used to assess face-validity of the construct and/or attribute stimuli. Based on received feedback, adjustments to the construct/attribute names and/or stimuli may be made until good fit is achieved. Note that in some cases, images may be used instead of words.

In our example, we operationalized the target construct (Instagram), the non-target construct (MS Excel), and the attribute (Enjoyment) with six stimuli (i.e., representative words) each. First, we developed a list of each system's most common features by analyzing their functionality and having informal discussions with their users. Second, we asked 20 system users to review and face-validate the list, and we addressed their comments. Third, to ensure semantic equality, we modified or replaced some words to have an approximately equal number of characters in each construct's stimuli. Whereas it is virtually impossible to obtain exactly the same number of characters in each set, the objective is to make the words in each set visually similar. Fourth, by using the tool that we present in Appendix B, we asked a new group of 20 Instagram and MS Excel users to sort the words into categories. We questioned the users about whether they encountered any difficulty or experienced high cognitive load during the task. For this exercise, we used university students because they all had good familiarity with both Instagram and MS Excel. Based on their feedback, we made further adjustments until we agreed on the following list of stimuli: Instagram (*image*, *hashtag*, *video, photo, post, profile*) and MS Excel (*cell, row, formula, sheet, total, column*). We adapted the following stimuli for the *enjoyable* category of the attribute from the enjoyment instrument of Davis, Bagozzi, and Warshaw (1992): *pleasurable, fun, exciting, interesting, entertaining, amusing*. We selected the stimuli for the *unenjoyable* category of the attribute from the list of antonyms from the Merriam-Webster Dictionary: *joyless, dull, boring, mundane, ordinary, routine*. We outline the IAT design in Table 2.

**Table 2. The IAT Design (Version 1)**

| Block # | Purpose | # of Trials | Left key | Right key |
|---|---|---|---|---|
| 1 | Practice: learning the construct dimension | 20 | Construct: Instagram (image, hashtag, video, photo, post, profile) | Construct: MS Excel (cell, row, formula, sheet, total, column) |
| 2 | Practice: learning the attribute dimension | 20 | Attribute: Enjoyable (pleasant, fun, exciting, interesting, entertaining, amusing) | Attribute: Unenjoyable (unpleasant, boring, mundane, routine, dull, ordinary) |
| 3 | Test: construct–attribute pairing is congruent | 40 | Instagram + Enjoyable | MS Excel + Unenjoyable |
| 4 | Practice: learning to switch the spatial location of the constructs | 20 | Construct: MS Excel | Construct: Instagram |
| 5 | Test: construct–attribute pairing is incongruent | 40 | MS Excel + Enjoyable | Instagram + Unenjoyable |

## 4.3 Administration

Researchers need to consider several important points when they administer the IAT. First, we recommend that researchers provide their subjects with the operational definitions of the terms if these

are ambiguous or context dependent. For example, this recommendation applies when measuring implicit attitude toward BitTorrent in the context of online piracy. In contrast, there is no need to define Instagram, Facebook, or LinkedIn for the sample of student subjects. Second, subjects should familiarize themselves with the constructs, attribute, and stimuli a priori. To help them do so, researchers can ask them to spend several minutes reviewing a list of terms before the test. Third, to avoid technical issues and clear any misunderstandings about the process (e.g., which key belongs to which side), researchers can briefly demonstrate the test's basic functionality. To do so, they can conduct a live session or show instructions with screenshots. We also found brief practice sessions to be useful. Fourth, the demo and/or instructions should pertain to the technical and administrative issues, and researchers should not reveal the test's actual purpose. Based on our experience, it is best to describe the IAT as part of the study of user perceptions of a particular IT system and keep the description very general and somewhat open to interpretation. If needed, researchers can brief subjects after the IAT.

Fifth, the IAT only works if subjects sort the items as quickly as possible while trying to minimize the number of mistakes. Speed has parsimonious importance because it allows subjects to suppress conscious cognitive processes and to rely on implicit ones. Thus, the instructions, demonstration, and/or tutorial should strongly emphasize the importance of performance speed and accuracy. However, due to the emphasis on performance speed, subjects are expected to make mistakes by misclassifying some of the stimuli. Indeed, the algorithm includes mistakes to calculate the implicit attitude score. Researchers should inform subjects that some errors may normally occur yet that they should do their best to minimize misclassifications. Sixth, researchers may administer the IAT to each subject individually or to a group. However, researchers need to ensure an interruption-free environment; thus, they need to eliminate possible noise, distractions, and so on. Seventh, despite researchers' best effort, some unanticipated issues may arise which may confound the results. For example, we have observed that, even after we instructed subjects to turn off their phones, a few of them still received a notification message on their phone during the test. One subject simply sneezed halfway through the test which reduced the reliability and validity of the scores and made the scores non-usable (we further discuss this issue in Section 5.4). Another accidentally dropped something on the floor and automatically tried to pick it up. Such interruptions have no impact on the subjects' scores if these occur when they complete Blocks 1, 2, and 4 (which are used for practice and are not scored). However, since researchers may have no way of knowing that, we advise them to flag these subjects and later review and potentially remove their scores from the dataset. Finally, as is always the case, subjects should be highly motivated to complete the test to the best of their ability. For example, researchers can motivate students with bonus points and Amazon's mTurk workers with fair compensation. We also noticed that a good motivational talk right before the test and an opportunity to contact the researchers to receive their scores and their interpretation have worked well (note that out of hundreds of students who enrolled in our IAT administrations, only a few ever have asked to review their scores; thus, this promise will not likely burden researchers).

Another issue is a decision whether to address the confounding effect of a single IAT version and the sequence in which the entire methodological procedure is done. The IAT may be designed in four different versions where the constructs and the attributes are assigned to the left and the right keys in different sequences, and the pairs in Blocks 3 and 5 may be rotated (as we later discuss in Section 5.4, doing so requires a manual adjustment of the scores). We present a single-version IAT (which we consider version 1) in Table 2 and versions 2, 3, and 4 in Table 3.

In most cases, the overall experimental procedure contains the IAT and a collection of other quantitative measures, such as a survey that measures explicit attitude toward an IT artifact. To further prevent a potentially confounding effect of the experimental procedure, half of the subjects may complete the IAT followed by a survey, and the rest may do so in a different order (i.e., a survey followed by the IAT). In this case, the entire procedure includes eight different sequences. On the one hand, the approach above may counterbalance a possible confounding effect of the experimental procedure. On the other hand, it dramatically increases the complexity of the overall process and the probability of mistake. In addition, in our previous IAT studies (Serenko & Turel, 2019, 2020b; Turel & Serenko, 2020), we have not observed a confounding effect of IAT versions and the order in which the experimental procedure was done. Moreover, a vast majority of IAT-based studies rely on a single IAT version and an experimental procedure. However, given a limited volume of IAT research in the IS domain, we cannot yet rule out the confounding effect above and we leave it up to the IS researchers to select the best course of action when conducting their studies.

## 4.4 Theoretical Explanation and the Scoring Algorithm

The IAT relies on the assumption that the stronger the subconscious mental association between the target construct (i.e., the attitude object) and the attribute (i.e., the attitude), the faster and more accurately subjects perform categorization tasks. We can explain this assumption from the perspective of information processing theory (Miller, 1956). This theory suggests that people develop cognitive representations of several congruent items in the form of a chunk, "a collection of elements having strong associations with one another, but weak associations with elements within other chunks" (Gobet et al., 2001, p. 236). Chunking is an automatic process that increases memory capacity, boosts its efficiency, and reduces the amount of cognitive resources required to memorize and retrieve information (Gobet et al., 2001). As users interact with Instagram, they develop attitude which becomes associated with this system. Imagine an individual who frequently uses Instagram for hedonic purposes, consistently enjoys the experience, and, as a result, has strong positive attitude toward it. In this case, the individual starts associating Instagram (the object) with enjoyment (the attitude), and the object and the attitude together represent a single mental element (or chunk) in his or her subconscious mind.

**Table 3. The IAT Design (Additional Versions)**

| Block # | Left key | Right key |
|---|---|---|
| Version 2 | | |
| 1 | Construct: MS Excel | Construct: Instagram |
| 2 | Attribute: Unenjoyable | Attribute: Enjoyable |
| 3 | MS Excel + Unenjoyable | Instagram + Enjoyable |
| 4 | Construct: Instagram | Construct: MS Excel |
| 5 | Instagram + Unenjoyable | MS Excel + Enjoyable |
| Version 3 | | |
| 1 | Construct: MS Excel | Construct: Instagram |
| 2 | Attribute: Enjoyable | Attribute: Unenjoyable |
| 3 | MS Excel + Enjoyable | Instagram + Unenjoyable |
| 4 | Construct: Instagram | Construct: MS Excel |
| 5 | Instagram + Enjoyable | MS Excel + Unenjoyable |
| Version 4 | | |
| 1 | Construct: Instagram | Construct: MS Excel |
| 2 | Attribute: Unenjoyable | Attribute: Enjoyable |
| 3 | Instagram + Unenjoyable | MS Excel + Enjoyable |
| 4 | Construct: MS Excel | Construct: Instagram |
| 5 | MS Excel + Unenjoyable | Instagram + Enjoyable |

During the IAT, the construct–attitude pairs in Block 3 and Block 5 (which are used for scoring) remain unchanged in each block whereas stimuli appear randomly in the center of the screen (the same stimulus may not appear twice in a row). The stronger the subject associates Instagram with enjoyment, the more likely the subject perceives them as a single, uniform visual chunk located in the corner of the computer screen. Thus, congruent construct–attitude pairs (Block 3, version 1) represent a single chunk in the subject's mind, which makes a sorting task faster and more accurate due to automaticity and decreased cognitive load. In contrast, the subject views incongruent construct–attitude pairs (Block 5, version 1) as two distinct, independent items, which, in turn, requires reflection, consumes mental resources, slows down the subject's performance, and increases the number of errors.

The IAT score is referred to as the GNB score and is calculated according to Greenwald, Nosek, and Banaji's (2003) algorithm. We present this scoring algorithm below. Note that it applies to test versions 1 and 2. For test versions 3 and 4, the sign of the GNB score must be changed.

**Step 1: ignore responses in Blocks 1, 2, and 4.**

In Blocks 1 and 2, the subject learns to classify the construct and the attribute and to memorize their spatial position. In Block 4, the spatial position of the construct changes, and the subject is expected to memorize its new position.

**Step 2: remove response latencies exceeding 10,000 ms.**

The subjects are instructed to respond as quickly as possible, and the responses that take too long are based solely on deliberate thinking (i.e., explicit processes take over implicit ones).

**Step 3: identify and count all response latencies below 300 ms. If their number exceeds 10 percent of all trials, the subject is disqualified, and the data is discarded.**

The minimum threshold required to identify and classify the item is 300 ms. Responding faster usually means that the subject did not read the stimulus and responded randomly. Whereas generating several extremely fast responses is acceptable (e.g., pressing the key too fast due to stress), having more than 10 percent of random responses invalidates the test score.

**Step 4: for all correct trials in Block 3, mean reaction time is calculated (the mean of correct trials in Block 3).**

Block 3 includes a congruent construct–attitude pair. It represents the mean reaction time which is the average time it took the subject to correctly classify a stimulus.

**Step 5: for all correct trials in Block 5, mean reaction time is calculated (the mean of correct trials in Block 5).**

Block 5 includes an incongruent construct–attitude pair. It represents the mean reaction time which is the average time it took the subject to correctly classify a stimulus.

**Step 6: all correct and incorrect trials in Blocks 3 and 5 are combined, and their standard deviation is calculated (the Pooled Standard Deviation).**

The Pooled Standard Deviation is a measure of dispersion of reaction times in Blocks 3 and 5. It reflects the degree of speed consistency during the test.

**Step 7: for all incorrect trials in Block 3, reaction times are replaced with the mean of correct trials in Block 3 plus a penalty of 600 ms.**

In Block 3, when an item is classified incorrectly, the reaction time is irrelevant in terms of the IAT score. Instead, assigning the mean + 600 ms represents the penalty in form of longer response time (i.e., 600 ms is a penalty for an incorrect classification attempt).

**Step 8: for all incorrect trials in Block 5, reaction times are replaced with the mean of correct trials in Block 5 plus a penalty of 600 ms.**

In Block 5, when an item is classified incorrectly, the reaction time is irrelevant in terms of the IAT score. Instead, assigning the mean + 600 ms represents the penalty in form of longer response time (i.e., 600 ms is a penalty for an incorrect classification attempt).

**Step 9: for Block 3, all correct trials and replaced incorrect trials (from step 7) are combined, and their average is calculated (the mean of corrected trials in Block 3).**

The mean of corrected trials in Block 3 represents the average reaction time of combined correct and incorrect (considering the penalty) trials when the construct–attribute pair was congruent.

**Step 10: for Block 5, all correct trials and replaced incorrect trials (from step 8) are combined, and their average is calculated (the mean of corrected trials in Block 5).**

The mean of corrected trials in Block 5 represents the average reaction time of combined correct and incorrect (considering the penalty) trials when the construct–attribute pair was incongruent.

**Step 11: calculate the IAT score (i.e., GNB score) as follows:**

$$IAT\ Score = \frac{\text{Mean of Corrected Trials in Block 5} - \text{ Mean of Corrected Trials in Block 3}}{\text{Pooled Standard Deviation}}$$

Thus, the IAT score is the difference in the speed and accuracy of performance between Block 5, in which categories are incongruent, and Block 3, in which categories are congruent, divided by the pooled standard deviation.

### 4.5 Limitations

Despite the IAT's various advantages, it has some flaws. It can have reliability, validity, and predictive power issues that researchers should recognize. First, the IAT is sensitive to outliers, which may artificially increase or reduce its reliability estimates and predictive power (LeBel & Gawronski, 2009; LeBel & Paunonen, 2011). Second, various non-phenomenon related factors, such as the cultural stereotypes, cognitive states, self-motives, and emotions of test-takers, may affect reaction time, which is used to calculate the IAT scores (Arkes & Tetlock, 2004; Blair, 2002). Third, in social desirability bias-prone contexts, test-takers may figure out the test's purpose and try to fake it (Fiedler, Messner, & Bluemke, 2006), which is an unlikely yet possible threat. Fourth, in some contexts, the predictive power of implicit measures does not exceed that of explicit ones (Oswald, Mitchell, Blanton, Jaccard, & Tetlock, 2013) and can be negligible (Blanton et al., 2009). Note that a moderate average correlation (0.24) between implicit and explicit measures exists (Hofmann, Gawronski, Gschwendner, Le, & Schmitt, 2005), and its magnitude depends on the context (Greenwald et al., 2009). Thus, the predictive power of the measures that the IAT generates may relate to the IS-use context. Last, several types of the IAT exist, and some are more specialized than the others (e.g., single category implicit association test (Karpinski & Steinman, 2006; Trendel et al., 2018), child-oriented implicit association test (Baron & Banaji, 2006), and a personalized version of the IAT (De Houwer, Custers, & De Clercq, 2006)). Hence, the tool choice may create some variation in outcomes.

## 5 Demonstration

### 5.1 Overview

Even though several extensions of the IAT exist, management and psychology research has most frequently employed the original IAT (i.e., Greenwald & Farnham, 2000; Greenwald et al.,1998). Therefore, we use the classic IAT version with a 5-block design modification (Nosek, 2005) for demonstration purposes. To do so, we describe the measurement of implicit attitude toward a social networking site (Instagram). We selected Instagram as the target system because it is often employed routinely, and in many cases its use is rewarding and less-planned; these attributes serve as the basis for generating subconscious stimulus-behavior-reward associations that foster the development of implicit attitude. Therefore, we can reasonably expect that, in some situations, individuals have weak motivation and opportunity to construct explicit attitude by engaging in conscious deliberation and that implicit attitude may guide Instagram-related processes and states at least to some extent (Fazio, 1990). For instance, individuals engage in behaviors such as SNS use while driving (Turel & Qahri-Saremi, 2016), swearing on SNS (Turel & Bechara, 2017), or using SNS rather than studying (Turel & Qahri-Saremi, 2016) in an (at least partially) automatic and unplanned manner. In such cases, implicit attitude can drive these automatic behaviors because it bypasses reflections on these actions; with some reflection, most people would deem these behaviors problematic and inhibit them. In addition, there is an abundance of studies pertaining to various subconscious processes and states, such as habit and addiction (Andreassen, Torsheim, Brunborg, & Pallesen, 2012; Błachnio & Przepiorka, 2016; Polites & Karahanna, 2012), in the context of hedonic SNS.

Researchers who intend to design and administer the IAT can choose between various available software packages. Out of them, we selected *Free*IAT[2] (Meade, 2009). First, *Free*IAT works well across studies and situations (Wright & Meade, 2012). Second, it offers high customizability, and researchers have full autonomy over the selection of categories, attributes, and stimuli. Third, it is easy to learn and implement. Fourth, this software may be executed on multiple machines in the lab which may be done by a technician or students themselves. Fifth, it automatically calculates the GNB score (the IAT score) according to the improved Greenwald's algorithm (Greenwald et al., 2003). Last, as its name suggests, its use is free. It is distributed under the GNU General Public License as published by the Free Software Foundation. In addition, we have successfully used *Free*IAT in previous IS studies.

[2] Available online at https://meade.wordpress.ncsu.edu/freeiat-home

## 5.2 Configuration

The installation process is straightforward. It begins with downloading and executing FreeIATinstaller.exe (available at https://meade.wordpress.ncsu.edu/freeiat-home/freeiat-getting-started). By default, the files are installed in the following directory: C:\Program Files (x86)\FreeIAT 1.3.3, but we found it expedient to change the directory to the one associated with the study in which the test is going to be employed. Most importantly, the installed files are not bound to the computer; it is possible to copy the folder in which the files have been installed to another computer and run it from there. *Free*IAT contains a sample test on racial attitude, but if the researchers do not wish to demonstrate or use this particular sample test, they may delete the folder "example", especially if they need to move the test on multiple lab computers (which may save 50KB of memory on each machine and expedite the file-transfer process). The test may be also executed from a memory key on any PC (see Figure 2). To start the test, double-click FreeIAT_1.3.3.exe.

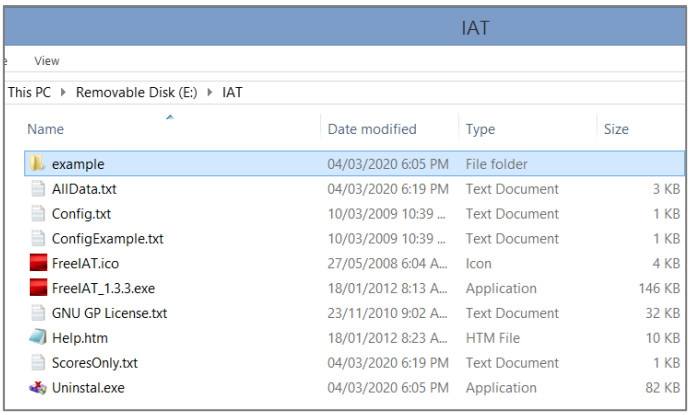


**Figure 2. *Free*IAT: Execution from a Memory Key**

The test may be configured in two ways: via the graphical user interface and by directly modifying the Config.txt file. The graphical user interface offers the option "SetUp" (see Figure 3); by choosing it, researchers may enter the test name and indicate whether they are going to use images (see Figure 4). In this tutorial, we limit our demonstration to the use of words only, because these are more appropriate in the current context. The test configuration is stored in the file Config.txt. Note that only a single Config.txt file may be stored in a folder in which the test is installed. If multiple versions are needed, the test files should be copied to other folders (e.g., folders IAT_V1, IAT_V2, IAT_V3, IAT_V4). The program will ask users whether they wish to override the previous Config.txt file when they configure the test (see Figure 5); note that selecting the "no" option terminates the configuration process and closes the application.

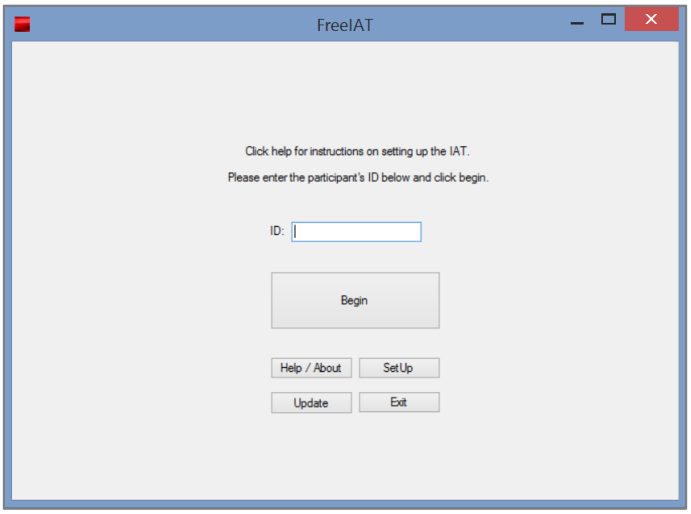


**Figure 3. *Free*IAT: The Main Interface**

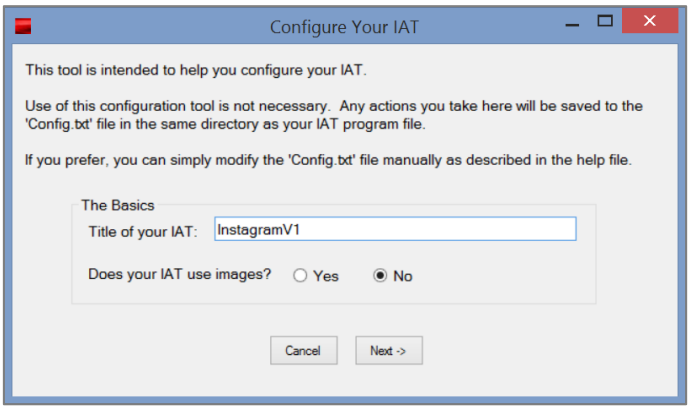


**Figure 4. *Free*IAT: Configuration Step 1**

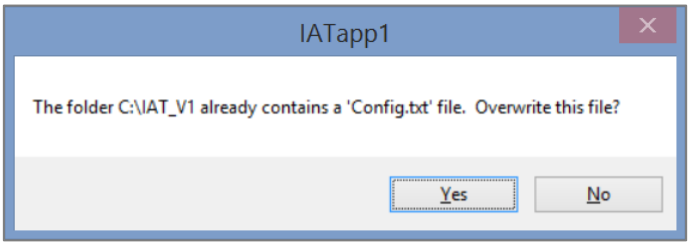


**Figure 5. *Free*IAT: Overriding Config.txt**

The main configuration task involves adding the construct (Instagram and MS Excel), the attribute (enjoyable and unenjoyable), and the stimuli (corresponding words). We present the related interfaces for version 1 of the test (as we describe in Table 2) in Figures 6 and 7. Next, researchers need to specify the number of trials per block, and we recommend using 20, 20, 40, 20, and 40 for Blocks 1, 2, 3, 4, and 5, respectively, because it represents the most commonly used IAT configuration (see Figure 8). The Config.txt file saves the selected configuration, which may be viewed in any word-processing application (see Figure 9). We recommend verifying the location of Config.txt, particularly when multiple test versions are being employed (see Figure 10).

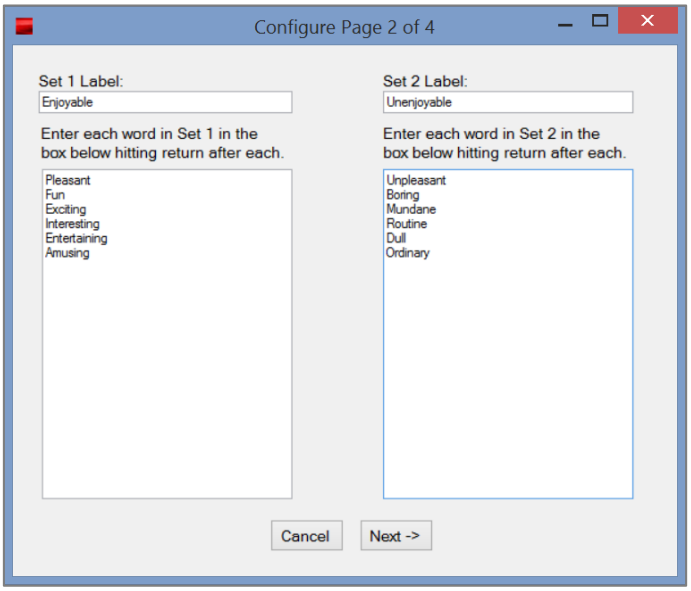


**Figure 6. *Free*IAT: Configuration Step 2**

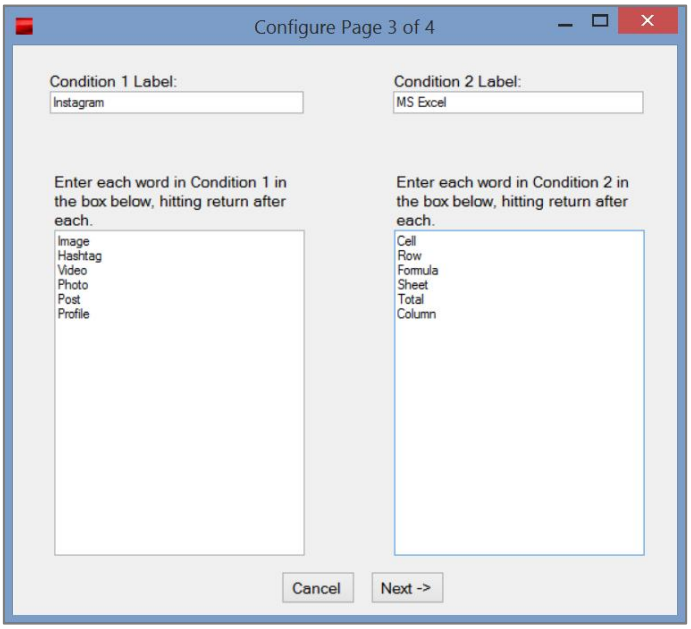


**Figure 7. *Free*IAT: Configuration Step 3**

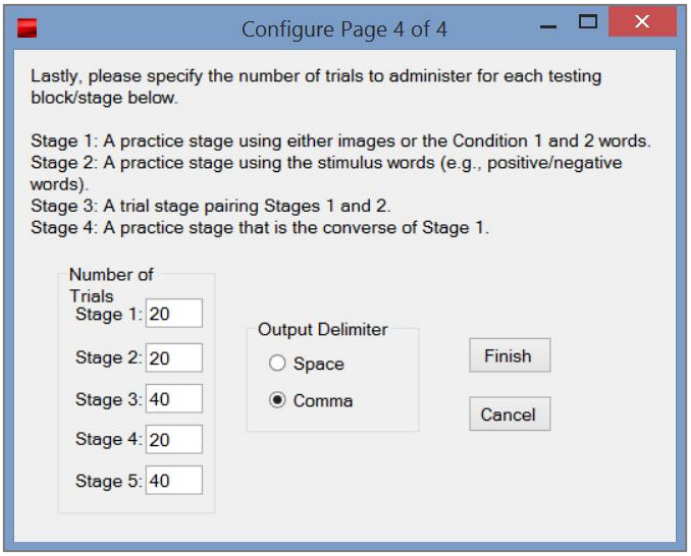


**Figure 8. *Free*IAT: Configuration Step 4**

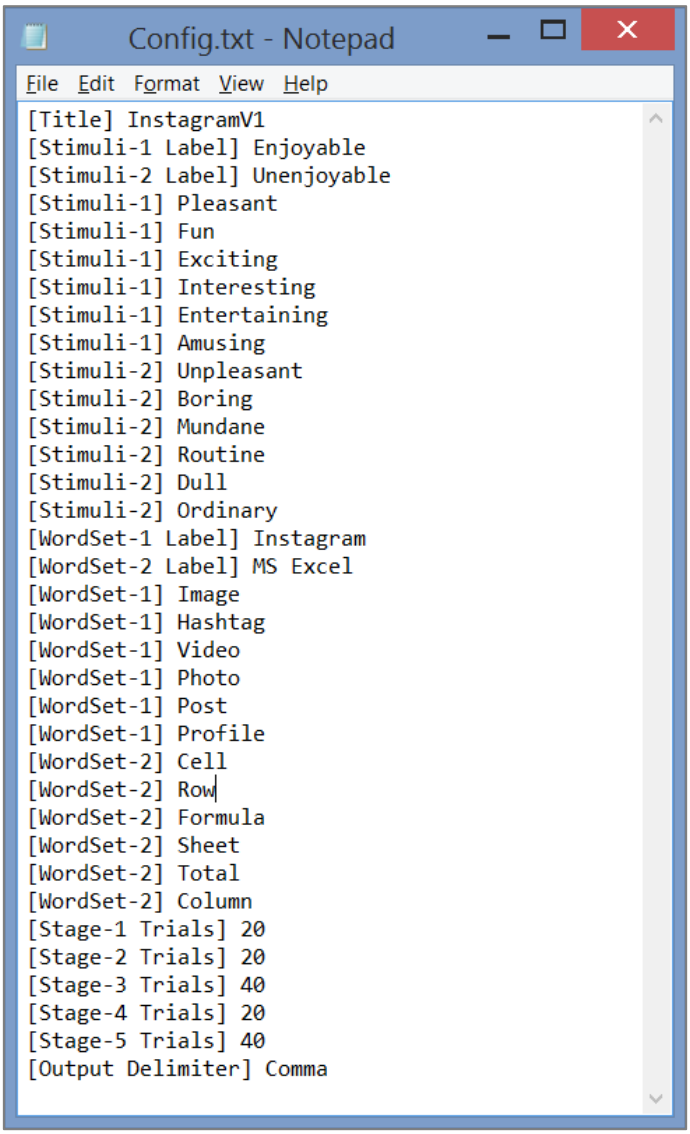


**Figure 9. *Free*IAT: Config.txt File**

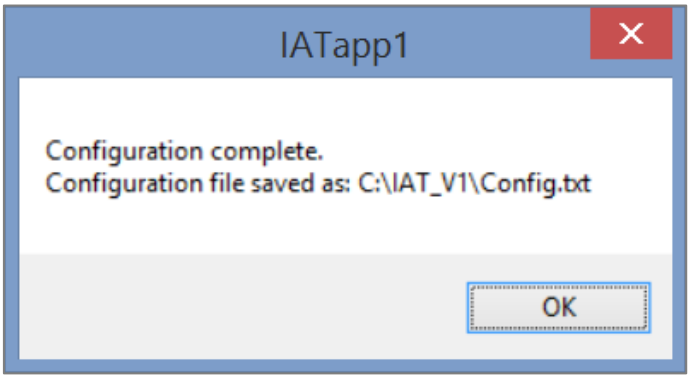


**Figure 10. *Free*IAT: Configuration Complete—Config.txt Location**

The advantage of the method above is that it offers a user-friendly, easy-to-use environment to design the IAT. However, we found it easier to configure *Free*IAT by directly modifying the text inside Config.txt. This approach is more efficient when designing multiple versions of the test because it is easy to copy-and-paste in the Config.txt file. In Appendix C, we present the four versions of Config.txt that we developed according to Table 2 and Table 3, which researchers can quickly add to their own Config.txt file.

## 5.3 Administration

Designing and delivering clear instruction to subjects represent one of the test's most crucial stages. *Free*IAT includes basic instructions for subjects (see Figure 11), but we recommend presenting subjects with more detailed instructions as we describe in Appendix D. We also found it effective to briefly present the instructions and the subsequent test procedure immediately before administering the test, which includes practice sessions. Note that the instructions refer to a "computer test" rather than the IAT (they never mention the "implicit association test"), and they do not reveal the study's actual purpose. When administering the IAT, researchers usually collect explicit measures (e.g., explicit attitude) via a survey. To minimize order bias, half of the subjects may complete the survey before the IAT, and the other half may do so in reverse order. Note that administering multiple IAT versions (e.g., four) accompanied by two different task orders results in eight different experimental procedures. So far, we have not observed the order of IAT versions and tasks to have a statistically significant confounding effect on the GNB score, but it may be too early to make generalizable conclusions based on several studies only.

Furthermore, we have observed that most subjects complete the IAT from 3.5 to 4 minutes. Introducing the instructions, demonstrating the test, and possibly allowing the subjects to "test drive" the IAT takes from five to 15 minutes and it varies among the subjects. Overall, the entire process should not take more than 20 minutes.

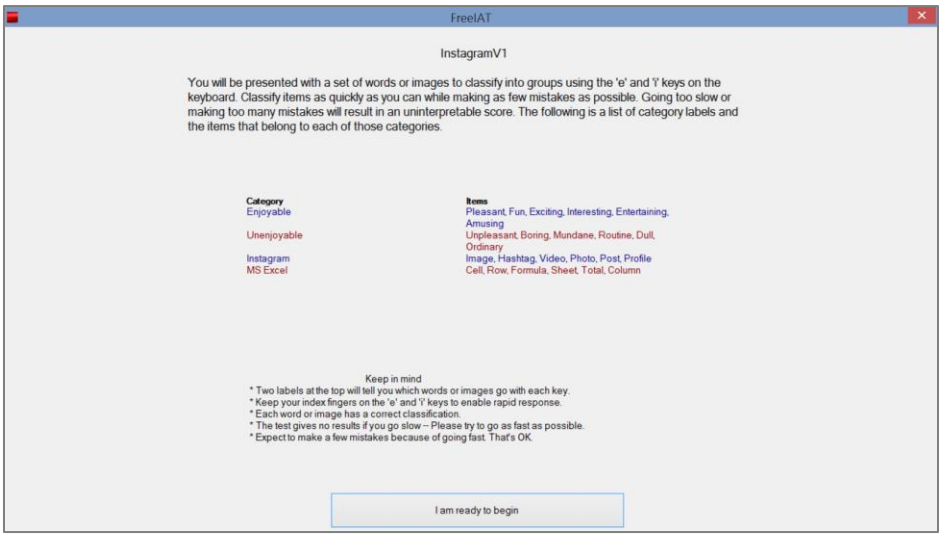


**Figure 11. *Free*IAT: The Built-in Instructions**

## 5.4 Scores

*Free*IAT reports the results in two files: alldata.txt and scoresonly.txt. The former file contains the raw data employed in the calculation of the scores (i.e., the subject's performance on each classification attempt in every block). This data may be useful if researchers choose to calculate the IAT score by following a procedure different from the one that Greenwald et al. (2003) recommend. The latter file contains ready-to-use, calculated data (see Figure 12). This output contains three ready-to-use values of interest to IS researchers: the overall GNB score calculated based on all stimuli (the first entry: 0.3374) (called GNB), the GNB score calculated based on the first half of the stimuli (the seventh entry: 0.3252) (called GNB1), and the GNB score calculated based on the second half of the stimuli (the eighth entry: 0.3496) (called GNB2). A positive GNB score indicates positive, a zero score indicates neutral (i.e., but not a lack of implicit attitude), and a negative score indicates negative implicit attitude. When multiple subjects complete the test on the same machine, the same output file stores their scores according to their ID.

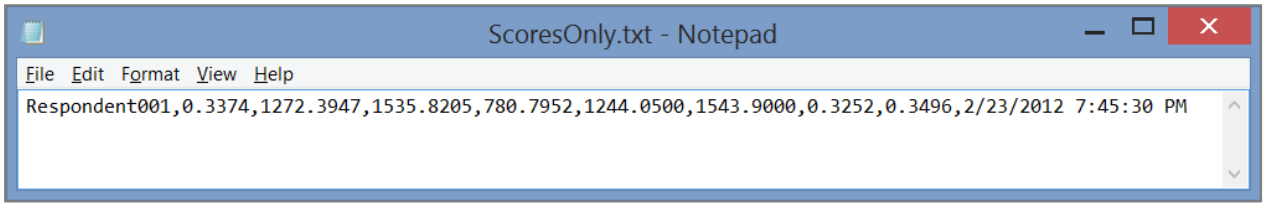


**Figure 12. *Free*IAT: ScoresOnly.txt**

When interpreting and using the GNB score, researchers may either use the overall score (i.e., GNB) or the scores calculated based on the first and the second half of the stimuli (i.e., GNB1 and GNB2) and treat GNB1 and GNB2 as reflective indicators of the overall implicit attitude latent variable. Most importantly, the latter approach allows researchers to calculate the construct's reliability measures, including Cronbach's alpha and composite reliability. We also recommend reviewing the GNB1 and GNB2 scores manually to identify extremely unreliable cases that contain a noticeable difference between the values. In our experience, most GNB scores range from 0 to 2.0, though some occasionally go as high as 2.5, and we have never observed a score that exceeds 3.5. They can be positive or negative depending on subjects' implicit attitude toward the IT artifact. Most importantly, GNB1 and GNB2 should be relatively close to each other. For example, the following combinations raise a red flag, and researchers should remove them from the dataset: GNB1 = 1.367, GNB2 = -1.434; GNB1 = 0.000, GNB2 = 1.877. To the best of our knowledge, in IS research, no acceptable failure rates for the measurement of implicit attitude by means of the IAT have been established yet. However, psychology research cites the failure rates as high as 46 percent (Oppenheimer, Meyvis, & Davidenko, 2009), and IS researchers admit that one can acceptably remove up to 10 percent of all unreliable entries (James, Lowry, Wallace, & Warkentin, 2017). Based on our experience, one may potentially eliminate between five to 10 percent of unreliable IAT results from the final dataset.

Researchers may deploy GNB1 and GNB2 scores as two reflective indicators in structural equation modelling (SEM) software packages, such as in Partial Least Squares (PLS) (e.g., see Serenko & Turel, 2019). They can also use the GNB score or to calculate the average of GNB1 and GNB2 scores and use it as a single measure in multivariate analysis of variance (MANOVA), regression, correlation analyses, and so on (e.g., see Turel & Serenko, 2020).

If researchers administer multiple versions of the test, switching the left and the right keys has no effect on the sign of the reported GNB score (i.e., they need to make no adjustment). However, when researchers rotate Block 3 (where the target construct and the attribute are congruent) and Block 5 (where the target construct and the attribute are incongruent) (i.e., in this case, Block 3 employs an incongruent pair, and Block 5 employs a congruent pair), researchers should change the sign of the GNB score. For example, Table 2 and Table 3 offer four different IAT versions (also see Appendix C for the corresponding Config.txt files). Out of them, versions 1 and 2 do not require researchers to adjust the sign of the GNB scores; however, in versions 3 and 4, they must change the sign of the GNB scores. For example, Respondent008 completed IAT version 3, and researchers should record this individual's scores as: 0.4456 (GNB), 0.4264 (GNB1), and 0.4648 (GNB2) (see Figure 13). Researchers should make the same adjustment for version 4.

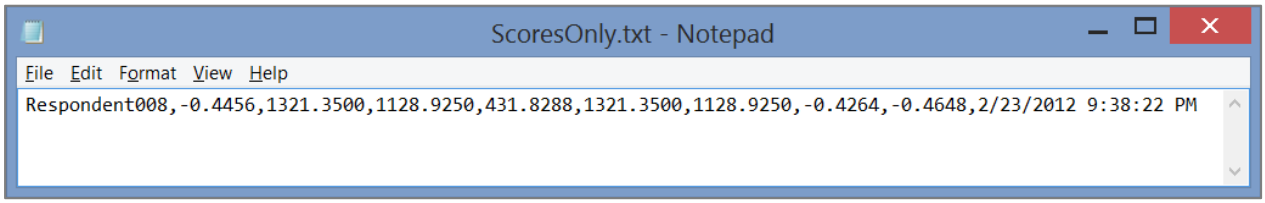


**Figure 13. *Free*IAT: ScoresOnly.txt (Version 3)**

# 6 Conclusion

Many IS scholars have already confirmed the potential usefulness and importance of subconscious mental processes, yet we need more empirical and theoretical progress in this area. We believe that implicit attitude represents a valid and important concept in IS research and that it has the potential to

influence subconscious user states and automatic behaviors. Future fruitful applications of the IAT in IS research may include addressing various questions, such as:

- Does implicit attitude toward IT security influence IT security compliance and misbehavior?
- Does IT security training change implicit attitude toward IT security and subsequent IT security behaviors?
- Can implicit attitude toward the use of an organizational IT influence continued use behaviors?
- Is implicit attitude toward a system related to its innovative use?
- Does implicit attitude toward the IT profession influence students' career choices? If so, can it be modulated through information sessions for incoming students?
- What role does implicit attitude play in the development of technology addiction?

The IAT may also help scholars address neuroIS questions, such as whether specific brain regions are associated with a stronger implicit attitude toward an IT and whether neuro-modulation techniques (e.g., transcranial direct current stimulation) can alter implicit attitude toward an IT.

In this tutorial, we discuss the concept of implicit attitude and demonstrate how to measure it to help IS researchers go beyond explicit, conscious attitudes and concepts in their investigations and to address questions such as the ones we state above. We hope that it forms the foundation for future inquiries into subconscious processes in IS users' minds and their role in shaping users' states, decisions, and behaviors.

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# Appendix A: Attribute Dimensionality

Attitude refers to "a psychological tendency that is expressed by evaluating a particular entity with some degree of favor or disfavor" (Eagly & Chaiken, 1993, p. 1). An entity refers to an attitude object "which is anything that is discriminable or held in mind" (Eagly & Chaiken, 2007, p. 583) that ranges from abstract concepts (e.g., hacktivism) to concrete examples of information systems (e.g., MS Word). In most cases, attitude is a complex construct that comprises a number of attributes, also referred to as dimensions of judgement (McGuire, 1989). People associate each attribute with an attitude object and form beliefs about it; the resulting attitude is the sum of beliefs about each individual attribute (Fabrigar, MacDonald, & Wegener, 2005; Fishbein, 1967; Oppenheim, 1966). In other words, attitude represents a multi-dimensional construct that comprises individual attributes.

However, people develop hierarchical ordering of attributes in terms of their importance. As a result, attributes often differ in terms of their salience; whereas some attributes dramatically contribute to the composite attitude, others are barely noticeable or have no impact (Lemon, 1973). Decomposing an overall attitude into a number of attributes has become a common technique in management research. For example, identifying salient dimensions of customer attitude toward a product or service is frequently employed in market segmentation (Hughes, 1971). Such attitudinal attributes, such as in evaluating automobiles, may include economy, reliability, style, comfort, safety, and so on—each of these attributes is usually considered and contributes to the overall attitude to a different degree. At the same time, attitude toward some objects or concepts (such as stand-up comedy) can be virtually unidimensional because a single attribute (such as entertainment) completely dominates the person's belief system.

We can apply the reasoning above to attitude objects in the IS domain: IS attitude objects comprise multiple attributes (dimensions of judgement) of varying salience. In some situations, however, overall attitude may be mostly driven by a single attribute. For example, a hedonic attribute is the primary component of attitude toward a videogame because a videogame's primary function is to facilitate enjoyment. In other cases, two or more attributes may be prominent. For instance, attitude toward a search engine may be composed of beliefs about its results comprehensiveness, relevance, speed, etc. The key objective is therefore to determine the most significant one(s) and understand how they affect IS users' cognitive, affective, and behavioral aspects.

In the IAT, only one attribute may be used in a single administration. Therefore, the IAT is most suitable for (somewhat) unidimensional attitude objects or in situations when researchers are interested in the effect of a particular attitudinal dimension. For example, overall attitude toward an enterprise resource planning system may be mostly determined by its ease of use (from the end user's perspective), toward LinkedIn by usefulness, and toward Facebook by enjoyment. Thus, these should be the attributes employed in the IAT unless researchers decide to intentionally focus on different phenomena. The centrality of attitude dimensions and the conceptual unidimensionality of the attitude objects can be pilot-tested.

# Appendix B: Assessing Construct and/or Attribute and Stimuli Fit

## Task 1

Please review and sort the words below into appropriate categories: unethical, truthful, indecent, decent, helpful, ethical, deceitful, corrupt, harmful, honest.

**Table B1. Sorting Task 1**

| Moral | Immoral |
|---|---|
| | |

## Task 2

Please review and sort the words below into appropriate categories: self, your, my, mine, them, own, they, their, other, I.

**Table B1. Sorting Task 2**

| Me | Others |
|---|---|
| | |

# Appendix C: *Free*IAT: Four IAT Versions (Config.txt File Example)

**Table C1. Config.txt (Instagram)**

| Version 1 | Version 2 | Version 3 | Version 4 |
|---|---|---|---|
| [Title] InstagramV1 | [Title] InstagramV2 | [Title] InstagramV3 | [Title] InstagramV4 |
| [Stimuli-1 Label] Enjoyable | [Stimuli-1 Label] Unenjoyable | [Stimuli-1 Label] Enjoyable | [Stimuli-1 Label] Unenjoyable |
| [Stimuli-2 Label] Unenjoyable | [Stimuli-2 Label] Enjoyable | [Stimuli-2 Label] Unenjoyable | [Stimuli-2 Label] Enjoyable |
| [Stimuli-1] Pleasant | [Stimuli-1] Unpleasant | [Stimuli-1] Pleasant | [Stimuli-1] Unpleasant |
| [Stimuli-1] Fun | [Stimuli-1] Boring | [Stimuli-1] Fun | [Stimuli-1] Boring |
| [Stimuli-1] Exciting | [Stimuli-1] Mundane | [Stimuli-1] Exciting | [Stimuli-1] Mundane |
| [Stimuli-1] Interesting | [Stimuli-1] Routine | [Stimuli-1] Interesting | [Stimuli-1] Routine |
| [Stimuli-1] Entertaining | [Stimuli-1] Dull | [Stimuli-1] Entertaining | [Stimuli-1] Dull |
| [Stimuli-1] Amusing | [Stimuli-1] Ordinary | [Stimuli-1] Amusing | [Stimuli-1] Ordinary |
| [Stimuli-2] Unpleasant | [Stimuli-2] Pleasant | [Stimuli-2] Unpleasant | [Stimuli-2] Pleasant |
| [Stimuli-2] Boring | [Stimuli-2] Fun | [Stimuli-2] Boring | [Stimuli-2] Fun |
| [Stimuli-2] Mundane | [Stimuli-2] Exciting | [Stimuli-2] Mundane | [Stimuli-2] Exciting |
| [Stimuli-2] Routine | [Stimuli-2] Interesting | [Stimuli-2] Routine | [Stimuli-2] Interesting |
| [Stimuli-2] Dull | [Stimuli-2] Entertaining | [Stimuli-2] Dull | [Stimuli-2] Entertaining |
| [Stimuli-2] Ordinary | [Stimuli-2] Amusing | [Stimuli-2] Ordinary | [Stimuli-2] Amusing |
| [WordSet-1 Label] Instagram | [WordSet-1 Label] MS Excel | [WordSet-1 Label] MS Excel | [WordSet-1 Label] Instagram |
| [WordSet-2 Label] MS Excel | [WordSet-2 Label] Instagram | [WordSet-2 Label] Instagram | [WordSet-2 Label] MS Excel |
| [WordSet-1] Image | [WordSet-1] Cell | [WordSet-1] Cell | [WordSet-1] Image |
| [WordSet-1] Hashtag | [WordSet-1] Row | [WordSet-1] Row | [WordSet-1] Hashtag |
| [WordSet-1] Video | [WordSet-1] Formula | [WordSet-1] Formula | [WordSet-1] Video |
| [WordSet-1] Photo | [WordSet-1] Sheet | [WordSet-1] Sheet | [WordSet-1] Photo |
| [WordSet-1] Post | [WordSet-1] Total | [WordSet-1] Total | [WordSet-1] Post |
| [WordSet-1] Profile | [WordSet-1] Column | [WordSet-1] Column | [WordSet-1] Profile |
| [WordSet-2] Cell | [WordSet-2] Image | [WordSet-2] Image | [WordSet-2] Cell |
| [WordSet-2] Row | [WordSet-2] Hashtag | [WordSet-2] Hashtag | [WordSet-2] Row |
| [WordSet-2] Formula | [WordSet-2] Video | [WordSet-2] Video | [WordSet-2] Formula |
| [WordSet-2] Sheet | [WordSet-2] Photo | [WordSet-2] Photo | [WordSet-2] Sheet |
| [WordSet-2] Total | [WordSet-2] Post | [WordSet-2] Post | [WordSet-2] Total |
| [WordSet-2] Column | [WordSet-2] Profile | [WordSet-2] Profile | [WordSet-2] Column |
| [Stage-1 Trials] 20 | [Stage-1 Trials] 20 | [Stage-1 Trials] 20 | [Stage-1 Trials] 20 |
| [Stage-2 Trials] 20 | [Stage-2 Trials] 20 | [Stage-2 Trials] 20 | [Stage-2 Trials] 20 |
| [Stage-3 Trials] 40 | [Stage-3 Trials] 40 | [Stage-3 Trials] 40 | [Stage-3 Trials] 40 |
| [Stage-4 Trials] 20 | [Stage-4 Trials] 20 | [Stage-4 Trials] 20 | [Stage-4 Trials] 20 |
| [Stage-5 Trials] 40 | [Stage-5 Trials] 40 | [Stage-5 Trials] 40 | [Stage-5 Trials] 40 |
| [Output Delimiter] Comma | [Output Delimiter] Comma | [Output Delimiter] Comma | [Output Delimiter] Comma |

# Appendix D: Instructions: Implicit Attitude toward Instagram (Version 1)

Note: if administering multiple IAT versions, the sample screenshots and block explanations below should be adjusted accordingly.

**Computer test instructions**

Enter your student ID (we need this information to assign bonus points and to link your survey data to the computer test).

Click “begin”.

Read the instructions below in detail and do the test once. If something goes wrong and you did not finish the test (e.g., you got distracted or confused during the test), just close the application and restart the test.

You will need to sort words into categories. This task requires that you classify items as quickly as possible while making as few mistakes as you can. Going too slowly or making too many mistakes will distort the results. This task takes less than 5 minutes to complete. Below is a list of category labels and the items that belong to each category. Please familiarize yourself with the categories and items.

| Category | Item |
|---|---|
| Instagram | Image, hashtag, video, photo, post, profile |
| MS Excel | Cell, row, formula, sheet, total, column |
| Enjoyable | Pleasant, fun, exciting, interesting, entertaining, amusing |
| Unenjoyable | Unpleasant, boring, mundane, routine, dull, ordinary |

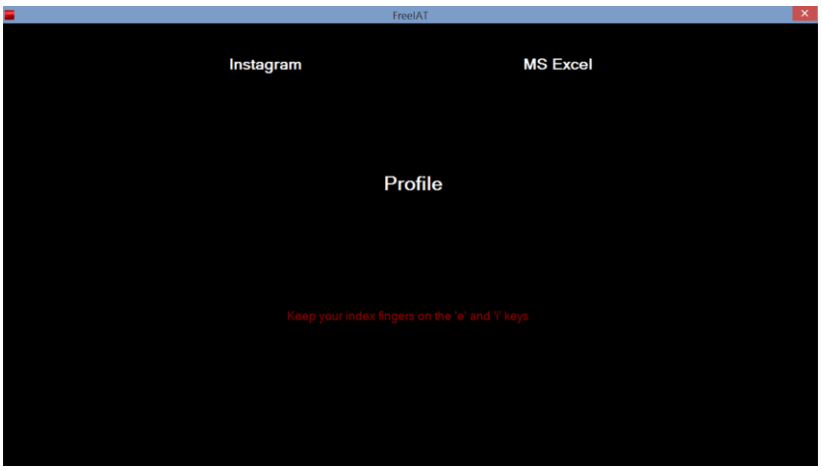
Please note:

- **Keep your index fingers on the “E” and “I” keys to enable quick response.**
- Words representing the categories at the top will appear one-by-one in the middle of the screen. When the item belongs to a category on the left, press the E key; when the item belongs to a category on the right, press the I key. Each item belongs to only one category.
- The test gives no results if you go slowly. Please try to go as fast as possible.
- Most people make a few mistakes because of going fast. That’s OK.

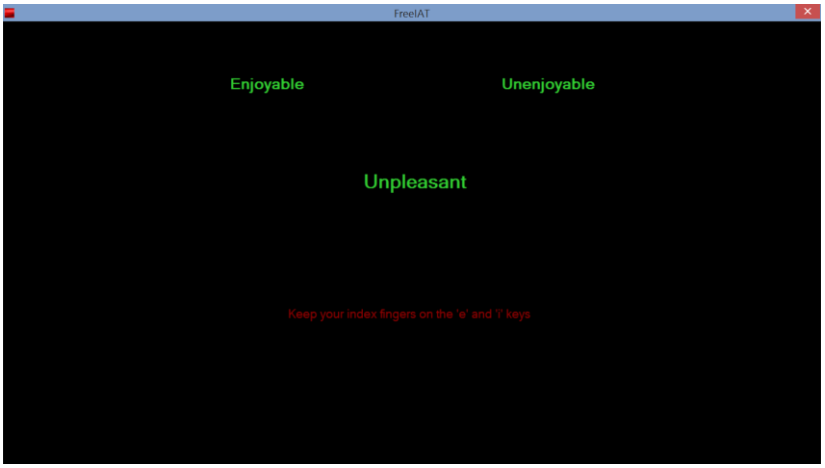
**This is a timed sorting task. GO AS FAST AS YOU CAN while making as few mistakes as possible. Going too slowly or making too many mistakes will distort the results.**

# The entire experiment includes five blocks

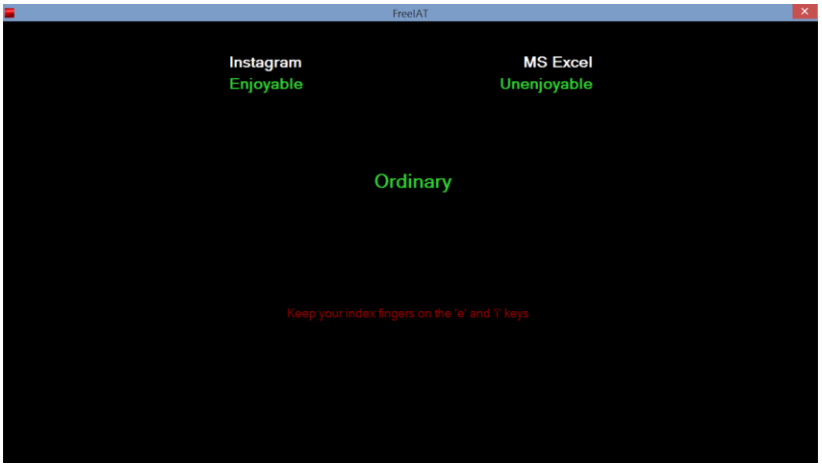
Block 1. You will see two categories (e.g., Instagram vs. MS Excel). Twenty items will appear one by one in the middle of the screen, and you will need to sort them into categories as fast and accurately as you can.



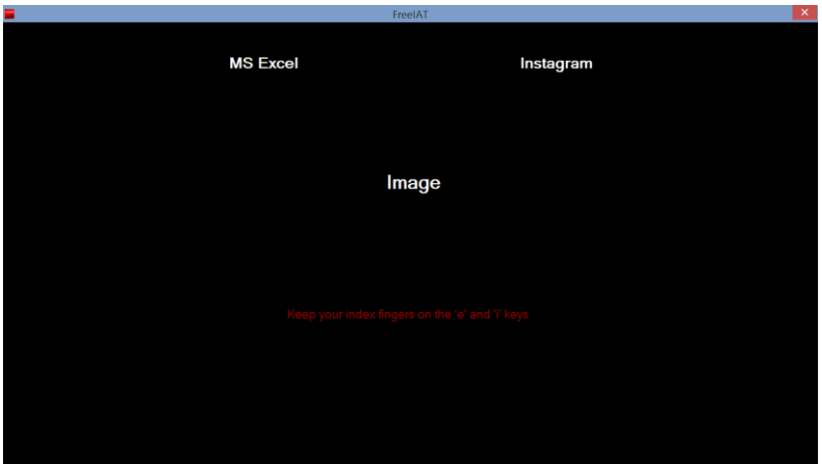

Block 2. You will see two new categories (e.g., enjoyable vs. unenjoyable). Again, you will need to sort 20 items into categories as fast and accurately as you can.



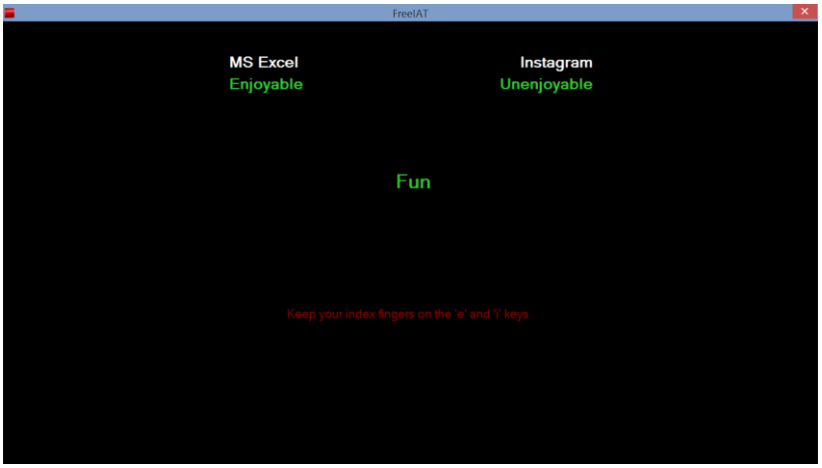

Block 3. Here, the categories you saw earlier will be combined (e.g., Instagram + enjoyable vs. MS Excel + unenjoyable). You will need to sort 40 items into categories as fast and accurately as you can.



Block 4. Here, the categories have switched their position. The rules, however, remain the same.




Block 5. Here, the combined categories have switched their position. The rules, however, remain the same.




If you make a mistake, an error sign will appear (see the sample screenshot). This is OK. Quickly press the other key and continue the test.

Please familiarize yourself one more time with the categories and items. Remember that you will need to quickly classify items as per the table below using the “E” and “I” keys.

| Category | Item |
|---|---|
| Instagram | Image, hashtag, video, photo, post, profile |
| MS Excel | Cell, row, formula, sheet, total, column |
| Enjoyable | Pleasant, fun, exciting, interesting, entertaining, amusing |
| Unenjoyable | Unpleasant, boring, mundane, routine, dull, ordinary |

**This is a timed sorting task. GO AS FAST AS YOU CAN while making as few mistakes as possible. Going too slowly or making too many mistakes will distort the results.**

**Good luck!**

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