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Abstract:

IS research has primarily focused on explicit perceptions, attitudes, and intentions of which users are largely aware. In this tutorial, we argue that this is a narrow view and present the concept of implicit attitude, defined 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 FreeIAT software package and offer a practical example and configuration of the IAT including its administration and scoring. Overall, this tutorial builds methodological foundations for future inquiries into the role of implicit attitude in IS research.

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

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) (Jospeh, 1992). The validity of this view and the significance of subconscious processes have received support in numerous studies of human behavior (Greenwald et al., 2009). The Information Systems (IS) literature has also emphasized the potential importance of such subconscious mental processes and described their measurement approaches (Ortiz de Guinea & Markus, 2009; Ortiz de Guinea, Titah, & Léger, 2014). In this tutorial, we extend this line of inquiry in two ways 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. It is important to be able to understand and measure implicit attitude of IS users for two reasons. First, the measurement of implicit attitude does not rely on self-reports, and, as a result, its measures 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, e.g., cyberdeviance (Venkatraman et al., 2018) and other socially unacceptable forms of use (Tarafdar, Gupta, & Turel, 2013), people may under- or over-report their true explicit attitude (Greenwald et al., 2009). This may bias models relying on explicit attitude but should have no impact on the hypothesized effects of implicit attitude, because users are typically unaware of it and, as a result, would find it difficult to introduce a deliberate bias during its measurement. Hence, the focus on implicit attitude can reduce inherent biases in system use models; this is similar to benefits of neuro-IS tools which may reduce several explicit measurement biases (Tams et al., 2014).

Second, implicit attitude can help researchers understand the formation of other subconscious states, especially in the context of unplanned, impulsive, or automatic IS use (Turel & Bechara, 2016). Subconscious states are not explained well by planned-behavior (Turel & Qahri-Saremi, 2016) and continued use (Kim & Malhotra, 2005) IS models, because they do not account for automatic user states and actions (Ortiz de Guinea & Webster, 2013). Studying implicit attitude is useful because it can influence other subconscious constructs through mechanisms that differ from those employed in conscious processes. For example, while explicit attitude (i.e., a conscious construct) influences behavior through the formation of behavioral intentions (Bhattacherjee, 2001; Venkatesh et al., 2008; Venkatesh et al., 2003), implicit attitude (i.e., a subconscious construct) can operate through two mechanisms: (1) it can directly trigger automatic behavioral responses without producing behavioral intentions (Belletier et al., 2018), and (2) it can 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 demonstrated in this tutorial, for many IS researchers it is feasible and easy to deploy. Even though IS research has made progress trying to understand the role of subconscious processes, the role of implicit attitude and its impact on other subconscious constructs have remained under-explored.

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 et al., 2020). As such, users are completely unaware of the mechanisms responsible for the cultivation and activation of subconscious processes, do not realize what triggered a potential course of action or mental state, and cannot control it. As a result, implicit attitude is below awareness levels and cannot be simply self-reported. One of the noteworthy challenges of accounting for implicit attitude is therefore 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 beyond user awareness and cannot be subjected to retrospective evaluation. Neuro-IS research has provided various implicit measures (Dimoka et al., 2012; Dimoka, Pavlou, & Davis, 2011; Riedl et al., 2010a; Tams et al., 2014), but neuro-IS tools may not be accessible to a majority of IS researchers, and their use requires a tremendous degree of expertise. Thus,

while neuro-IS tools are important, we believe that other means for capturing implicit processes may help extending the understanding of IS users' decisions, states, and behaviors. In this tutorial, we describe in detail the use of the IAT (Greenwald, McGhee, & Schwartz, 1998), which is a well-established, simple technique for capturing implicit attitude, and which has proven to have good predictive validity across contexts (Greenwald et al., 2009). We therefore help scholars understand, measure, and apply implicit attitude in IS research in order to easily tap into this important subconscious concept existing in IS users' minds, without the use of neuro-IS tools, as a means to supplement neuro-IS findings.

The rest of this tutorial is structured as follows. In the following section, we introduce and elaborate on the concept of implicit attitude. Next, we offer a historical overview of implicit measures. Then, we explain the IAT in detail, including its measures, constructs, attributes, stimuli, design, administration, theoretical foundations, scoring, and limitations. We conclude this tutorial with a demonstration of the IAT design by means of the *Free*IAT software package.

2 Implicit Attitude

Attitude is 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 explicit attitude of users by assuming 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 et al., 2006; Wilson, Lindsey, & Schooler, 2000).

The simultaneous existence and impacts of both conscious and subconscious processes have received some attention in IS research (Park et al., 2016; Serenko & Turel, 2016; Soror et al., 2015; Turel & Qahri-Saremi, 2018). These efforts 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 showing the existence and relevance of such systems for social media (He, Turel, & Bechara, 2017a, 2018; He et al., 2017b; Turel et al., 2018; Turel et al., 2014) and video game (Turel et al., forthcoming) 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; and largely point to the nature of each type of attitude – elaborated, effortful, and slow (i.e., explicit) vs. impulsive, effortless, and automatic (i.e., implicit).

A more formal treatment of explicit and implicit attitudes is provided by the model of dual attitudes (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 context of IS, 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 context of IS, 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 are fundamentally different along several dimensions (see Table 1) (Greenwald et al., 1998). First, while explicit attitude forms quickly through direct interaction with the system, for example, 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 the 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 a user may simply alter his or her overt beliefs about the 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, individuals 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; these are not always available. In contrast, implicit attitude is generated automatically and consumes little mental resources.

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

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 a number of 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). This happens because 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 user behavior and never triggers behavioral intentions (Belletier et al., 2018). In addition, implicit attitude has an impact on other subconscious mental processes and states.

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 et al., 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 et al. (2016) showed that people have developed a tendency to implicitly associate technology with success. Serenko & Turel (2016) measured subconscious gender-identity in order to predict gender-based differences in IT career choices. Weinert et al. (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. None of the previous IS studies has documented the use of the IAT in such a detail as to allow a busy IS researcher to quickly comprehend and being able to use this measurement technique. Thus, IS scholars may benefit from a comprehensive theoretical and methodological overview of the IAT presented 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 a variety of implicit measures which may be classified into four broad categories: accessibility-, interpretation-, neuropsychological-, 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 are founded 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) make use of specialized methods and tools, such as fMRI (functional magnetic resonance imaging), electroencephalography (EEG), skin conductance tests, and pupil dilation readings to capture neural correlates of the phenomena of interest. Recent developments in neuro-IS (Dimoka, 2010; Dimoka et al., 2012; Dimoka et al., 2011; Riedl, 2013; Riedl et al., 2010a; Riedl, Davis, & Hevner, 2014; Riedl, Hubert, & Kenning, 2010b; Riedl et al., 2012; Tams et al., 2014; Warkentin et al., 2016) propose ways to measure bio-physiological processes that, in many cases, are subconscious (e.g., people are not aware of their neuronal activity). Hence, the measurement of implicit attitude and neuro-IS 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 et al., 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, etc. (Lobello et al., 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 neuro-IS 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; Ames et al., 2013), but this route has not yet been taken in the neuro-IS stream of research. We hence see the IAT as a separate tool which can inform research beyond or in addition to the existing measures, including neuro-IS, and it can also be potentially integrated with neuro-IS studies, in a manner similar to those in which current neuro-IS 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 an 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 concept- and attribute-related stimuli into categories.

Initially, Fazio and colleagues introduced the *evaluative priming* techniques (Fazio et al., 1982; Fazio, Powell, & Herr, 1983) which were later extended as the affective priming test (Fazio et al., 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, the design, implementation, and administration of priming procedures are complicated and require technical expertise. Second, the administration of priming tasks is very time consuming because the process needs to be closely monitored to avoid the confounding effects of other variables. Third, the outcome of evaluative priming tests is highly sensitive to the type of objects used as primes. Last, the technique exhibits low internal consistency and produces small effect sizes. Therefore, another methodological approach for the measurement of implicit attitude was needed.

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). Because of its simplicity and accessibility to most researchers, the IAT has become the most well-known approach for the measurement of implicit attitude in psychology (De Houwer & Moors, 2010, 2012; Fazio & Olson, 2003). The results obtained with the use of the IAT and evaluative priming techniques are generally consistent (Cunningham, Preacher, & Banaji, 2001). As a result, 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. Particularly, 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 where the subjects are asked 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. Instagram will be used throughout the rest of this tutorial as the target system. MS Excel was selected as the non-target (contrast) construct which is required for the IAT administration as explained 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 a five-block design is accepted as the current IAT standard (Nosek, 2005). In addition, using fewer blocks reduces cognitive load on the subjects and improves test accuracy. Blocks 1, 2, and 4 (which consist of 20 trials each) are only for practice, but the subjects should be unaware of this. Blocks 3 and 5 consist of 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 consists of five steps.

Step 1. Identify the target construct.

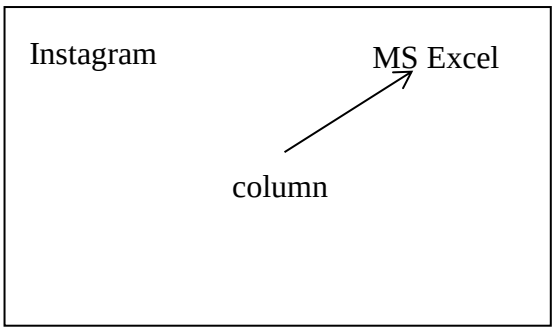
The target construct is the focal construct toward which implicit attitude is measured. It may be an object (e.g., an IT artifact), a person (e.g., an IT expert), an action (e.g., hacking), or a concept (e.g., copyright). If needed, the subjects should be provided with the construct's definition and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

To demonstrate the application of 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.

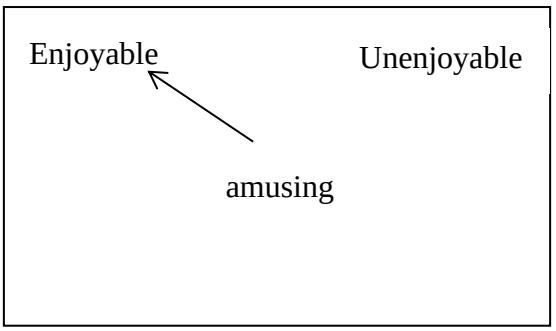
Step 2. Select the attribute.

This step specifies the type of a measured attitude. The attribute should perfectly reflect the most salient characteristic and quality of the target construct – ideally, it should match the type of attitude that automatically (without conscious effort) comes to mind when hearing 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. Note, however, 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

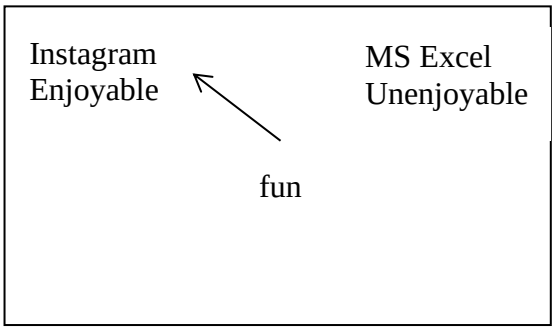
selected as a target construct, attributes may pertain to his or her personal characteristics, such as honesty (honest/dishonest), expertise (experienced/inexperienced), kindness (kind/unkind), etc. Thus, when making a decision on the attribute, researchers need to consider both its fit with the target construct and the purpose of the study. It is also recommended to determine the most common context of use and/or characteristics of the target construct to ensure that it is properly aligned with the proposed attribute. Appendix A provides a theoretical overview of the dimensionality of attributes in the IAT context. It is advised to do formal/informal interviews, experiments, and/or focus groups to select attributes and pilot-test all choices.



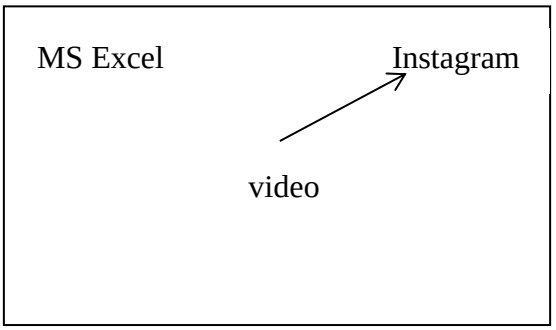
Block 1: Press the right (I) key



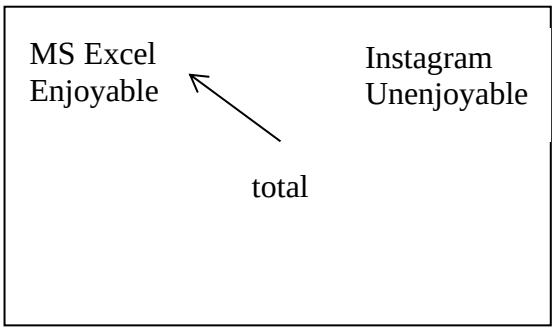
Block 2: Press the left (E) key



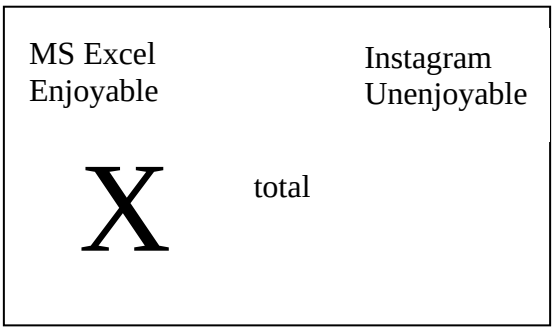
Block 3: Press the left (E) key



Block 4: Press the right (I) key



Block 5: Press the left (E) key



Block 5: The subject pressed the right (I) key, the error message appeared, and the subject should press the left (E) key to classify the item correctly and to continue the test

Figure 1. The IAT (Implicit Attitude toward Instagram)

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

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 also 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 implicit attitude is the difference between the attitude toward Instagram and that toward Twitter (based on the selected attribute, e.g., enjoyment). To measure the attitude toward the target construct only, 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 as justified later in this tutorial), 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).

We assume that the purpose of the hypothetical study in which the IAT is employed is 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 et al., 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, *Microsoft (MS) Excel* was employed 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). This view was confirmed empirically through informal interviews with 20 MS Excel users; they confirmed that the only reason they use it is to accomplish a particular task and to enhance their productivity. No hedonic factors were mentioned. When questioned whether they found its use to be enjoyable or unenjoyable, a neutral attitude was reported. In fact, most had neither positive nor negative valence toward the system; it was merely a productivity tool. Thus, it was assumed that MS Excel is a good non-target category within the context of the selected enjoyment attribute. Whereas Weinert et al. (2015) recommend the use of SAP as a contrast category for the administration of the IAT in the context of SNS, 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, including SAP, as a contrast category.

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. For example, images should be similar in size, and text should contain approximately the same number of words or be of somewhat similar length. For instance, Facebook Video Calling (the target construct) vs. Skype (the non-target construct) is 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. Another good example is Discord vs. Skype. In the present example, we believe that Instagram (9 characters) vs. MS Excel (8 characters with the space) is an acceptable combination.

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

[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.

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, the 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, the target construct (Instagram), the non-target construct (MS Excel), and the attribute (Enjoyment) were operationalized with six stimuli (i.e., representative words) each. First, a list of the most common features of each system was developed by analyzing their functionality and having informal discussions with their users. Second, 20 system users were asked to review and face-validate the list, and their comments were addressed. Third, to ensure semantic equality, some words were modified or replaced; the key purpose is 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 presented in Appendix B, a new group of 20 Instagram and MS Excel users was asked to sort the words into categories; they were questioned whether they encountered any difficulty or experienced high cognitive load during the task. For this exercise, we used university students because all of them are very familiar with both Instagram and MS Excel. Based on their feedback, further adjustments were made until the following list of stimuli was agreed on: Instagram (*image, hashtag, video, photo, post, profile*) and MS Excel (*cell, row, formula, sheet, total, column*). The following stimuli for the *enjoyable* category of the attribute were adapted from the enjoyment instrument of Davis (1992): *pleasurable, fun, exciting, interesting, entertaining, amusing*. The stimuli for the *unenjoyable* category of the attribute were selected from the list of antonyms from the Merriam-Webster Dictionary: *joyless, dull, boring, mundane, ordinary, routine*.

Table 2 outlines the IAT design.

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	20	MS Excel + Enjoyable	Instagram + Unenjoyable

4.3 Administration

There are several important considerations that IAT administrators need to be aware of. 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. For this, they may be asked 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), it is beneficial to offer a brief demo of the basic functionality of the test. This can be done during a live session or by showing a set of 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 the actual purpose of the test should not be revealed. 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, subjects may be briefed 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 is of parsimonious importance because if 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. This is, however, expected, and mistakes are included in the algorithm for the calculation of the implicit attitude score. Subjects should be informed that some errors may occur and this is normal, yet, they should do their best to minimize misclassifications. Sixth, the IAT may be administered to each subject individually or to a group. The key condition, however, is to ensure an interruption-free environment – it is the researchers' responsibility to eliminate all possible noise, distraction, etc. Seventh, despite the best researchers' effort, some unanticipated issues may arise which may confound the results. For example, we have observed that, regardless of the instructions to turn-off their phones, a few test subjects still received a notification message on their phone. One subject simply sneezed half-way 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. Such interruptions have no impact on the subjects' scores if they occur during the completion of Blocks 1, 2, and 4 (which are not scored and used for practice). However, since the researchers may have no way of knowing that, we advise to flag these subjects and later review and potentially remove their scores from the dataset. Finally, as it is always the case, subjects should be highly motivated to complete the test to the best of their ability. For example, students may be encouraged with bonus points and Amazon's mTurk workers with a 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 work very well (note that out of hundreds of students who enrolled in our IAT administrations, only a few ever asked to review their scores, thus, this promise is unlikely to burden the 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, this will require a manual adjustment of the scores). Table 2 presents a single version IAT (which may be considered version 1) and Table 3 offers versions 2, 3, and 4.

In most cases, the overall experimental procedure contains the IAT and a collection of other quantitative measures, for example, a survey measuring explicit attitude toward the 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, 2016, 2019; Turel & Serenko, 2020), we did not observe a confounding effect of IAT versions and the order in which the 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, it is too early to rule out the confounding effect above and we leave it up to the IS researchers to select the best course of action in the context of their study.

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

4.4 Theoretical Explanation and the Scoring Algorithm

The IAT is based 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) is, the faster and more accurately subjects perform categorization tasks. This may be explained 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, which is "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 her experience, and, as a result, has strong positive attitude toward it. In this case, she starts associating Instagram (the object) with enjoyment (the attitude), and the object and the attitude together represent a single mental element (or chunk) in her subconscious mind.

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 she is to perceive 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 her mind, which makes a sorting task faster and more accurate due to automaticity and decreased cognitive load. In contrast, incongruent construct-attitude pairs (Block 5, version 1) are viewed 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 the algorithm by Greenwald, Nosek, and Banaji (2003). This scoring algorithm is presented 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% of all trials, the subject is disqualified and the data is discarded.

300 ms is the minimum threshold required to identify and classify the item. 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 because of stress), having more than 10% 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 following:

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

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

4.5 Limitations

Despite the various advantages of the IAT, it is not perfect. It can have reliability, validity, and predictive power issues, of which researchers should be aware. 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, reaction time, which is used to calculate the IAT scores, may be affected by various non-phenomenon related factors, such as the cultural stereotypes, cognitive states, self-motives, and emotions of test-takers, all of which can affect test validity (Arkes & Tetlock, 2004; Blair, 2002). Third, in social desirability bias-prone contexts, test-takers may figure out the purpose of the test 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 et al., 2013) and can be negligible (Blanton et al., 2009). Note that there is a moderate average correlation (0.24) between implicit and explicit measures (Hofmann et al., 2005), and its magnitude is context-dependent (Greenwald et al., 2009). Thus, it is possible that the predictive power of the measures generated by the IAT is related to the context of IS use. Last, there are several types of the IAT, 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

Despite the existence of several extensions of the IAT, the original IAT (i.e., developed by Greenwald et al. (2000; 1998)) is the most frequent approach employed in management and psychology research. Therefore, we use the classical Greenwald's IAT version, with a 5-block design modification (Nosek, 2005), for demonstration purposes. For this, 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. It is, therefore, reasonable to expect that in some situations, the motivation and opportunity to construct explicit attitude by engaging in conscious deliberation are weak, and Instagram-related processes and states may be guided, at least to some extent, by implicit attitude (Fazio, 1990). For instance, behaviors such as SNS use while driving (Turel & Qahri-Saremi, 2016), swearing on SNS (Turel & Bechara, 2017), or using SNS instead of studying (Turel & Qahri-Saremi, 2016) are, at least in part, automatic and unplanned. In such cases, implicit attitude can be a driver of these automatic behaviors because it bypasses reflections on these actions; with some reflection, most people would deem these behaviors to be problematic and inhibit them. In addition, there is an abundance of studies pertaining to various subconscious processes in the context of hedonic SNS including a frequent manifestation of habit and addiction (Andreassen et al., 2012; Błachnio & Przepiorka, 2016; Polites & Karahanna, 2012).

Various software packages are available at the disposal of researchers who intend to design and administer the IAT. Out of them, we selected *Free*IAT[2] (Meade, 2009). First, *Free*IAT, works well across studies and situations (Wright & Meade, 2012). Second, it is highly customizable 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) by following the improved Greenwald's algorithm (Greenwald et al., 2003). Last, as its name suggests, its use is free. It is distributed

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

under the GNU General Public License as published by the Free Software Foundation. In addition, we have been able to successfully use *Free*IAT in previous IS studies.

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 on 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 (this 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.

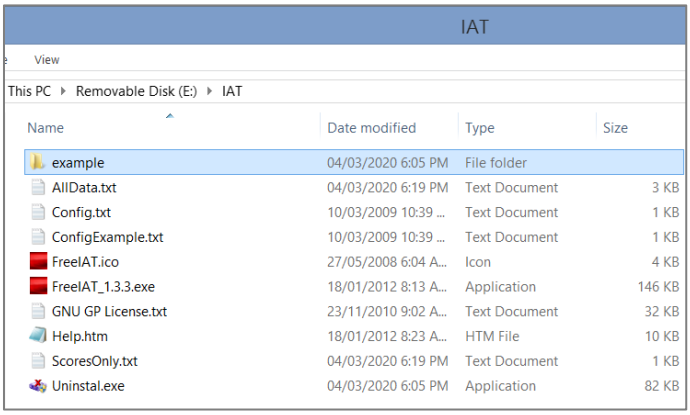


Figure 2. *Free*IAT – Execution from a Memory Key

The test may be configured in two ways: through 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 make use of 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). Thus, users will be asked whether they wish to override the previous Config.txt file (see Figure 5); note that selecting the "No" option terminates the configuration process and closes the application.

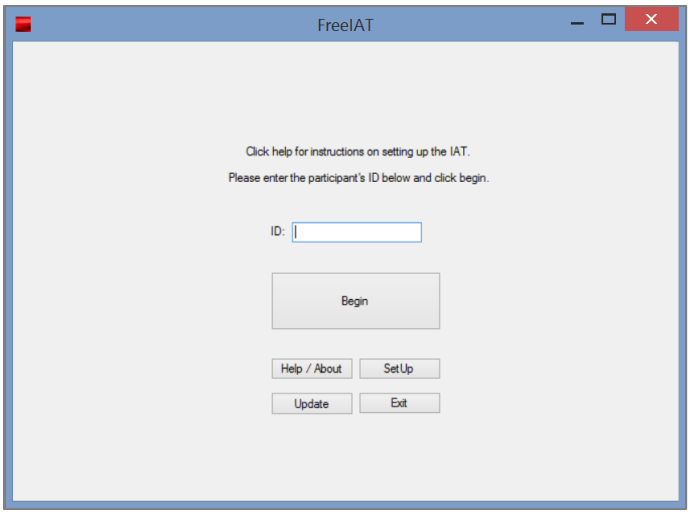


Figure 3. *Free*IAT – The Main Interface

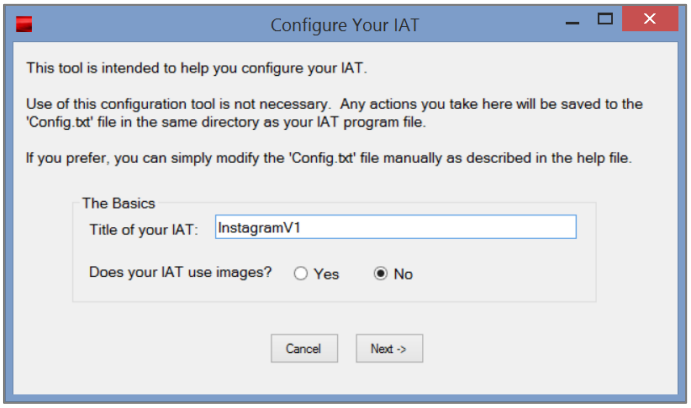


Figure 4. *Free*IAT – Configuration Step 1

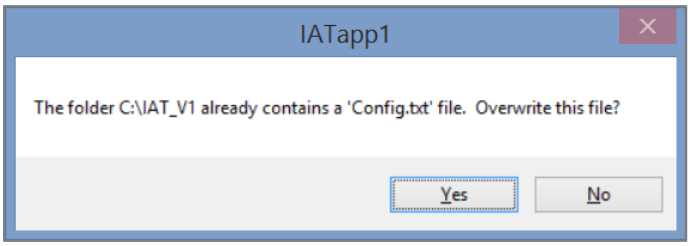


Figure 5. *Free*IAT – Overriding Config.txt

The main configuration task consists of adding the construct (Instagram and MS Excel), the attribute (Enjoyable and Unenjoyable), and the stimuli (corresponding words). Figure 6 and Figure 7 present the related interfaces for Version 1 of the test (as described in Table 2). Next, researchers need to specify the number of trial per block, and we recommend using 20, 20, 40, 20, and 40 for Blocks 1, 2, 3, 4, and 5, respectively, because this is the most commonly used IAT configuration (see Figure 8). The selected configuration is saved in the Config.txt file 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).

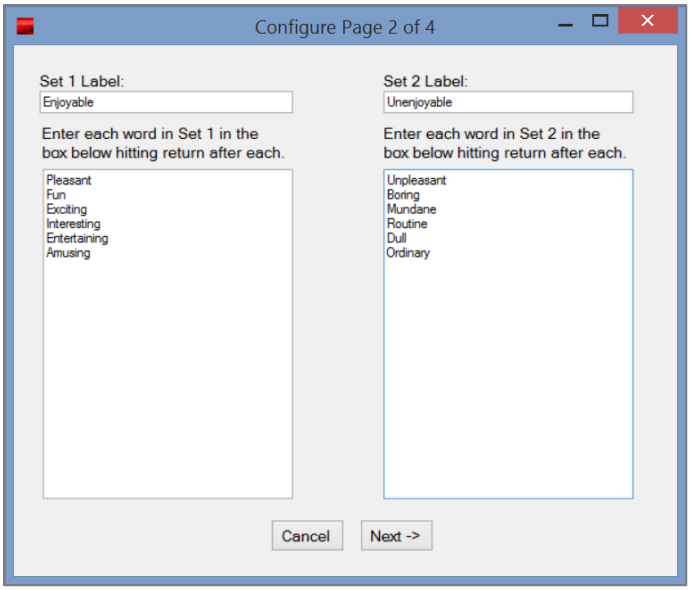


Figure 6. *Free*IAT – Configuration Step 2

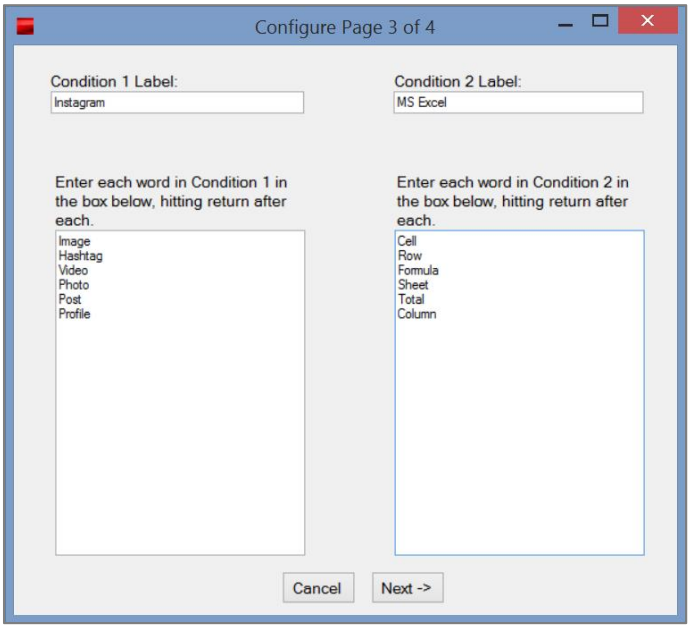


Figure 7. *Free*IAT – Configuration Step 3

Figure 8. *Free*IAT – Configuration Step 4

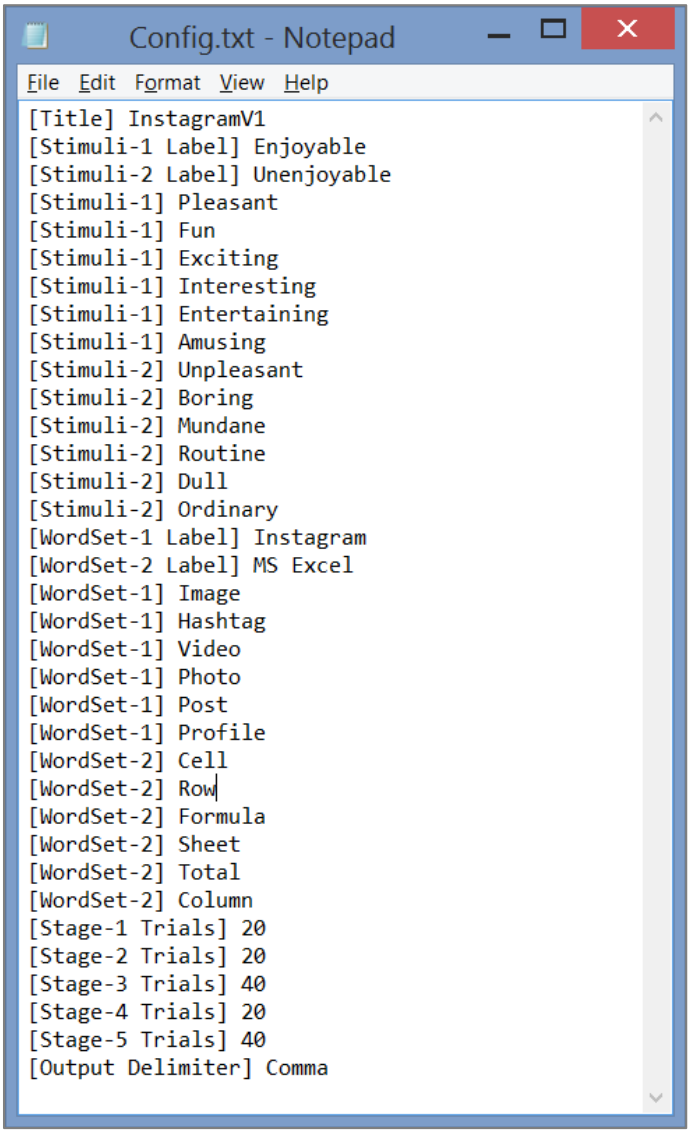


Figure 9. *Free*IAT – Config.txt File

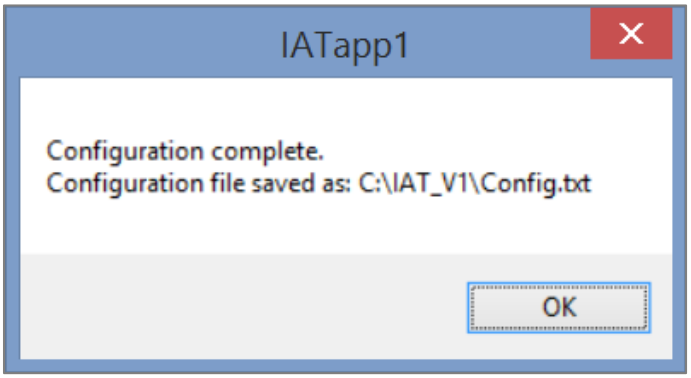


Figure 10. *Free*IAT – Configuration Complete – Config.txt Location

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 within Config.txt. Appendix C presents the content of four versions of Config.txt developed according to Table 2 and Table 3 which can be quickly added to Config.txt.

5.3 Administration

Designing and delivering clear instruction to subjects represent one of the most crucial stages of the test. Basic instructions are built into *Free*IAT (see Figure 11), but we recommend presenting subjects with a very detailed set of instructions as described in Appendix D. We also found it effective to do a brief presentation of the instructions and the subsequent test procedure immediately before the administration of the test, including practice sessions. Note that instructions refer to a "computer test" instead of the IAT ("implicit association test" is never mentioned), and the actual purpose of the study is not revealed. The IAT is usually accompanied by the collection of explicit measures (e.g., explicit attitude) by means of a survey. To minimize order bias, a half of the subjects may complete a survey, followed by the administration of the IAT, and the other half may do so in reverse order. Note that the administration of multiple IAT versions (e.g., four) accompanied by two different task orders results in eight different experimental procedures. So far, we have not observed a statistically significant confounding effect of the order in which explicit and implicit measures are collected, but it may be too early to make generalizable conclusions based on several studies only.

In terms of the duration of the experimental procedure, 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 5 to 15 minutes and it varies among the subjects. Overall, the entire process should not take more than 20 minutes.

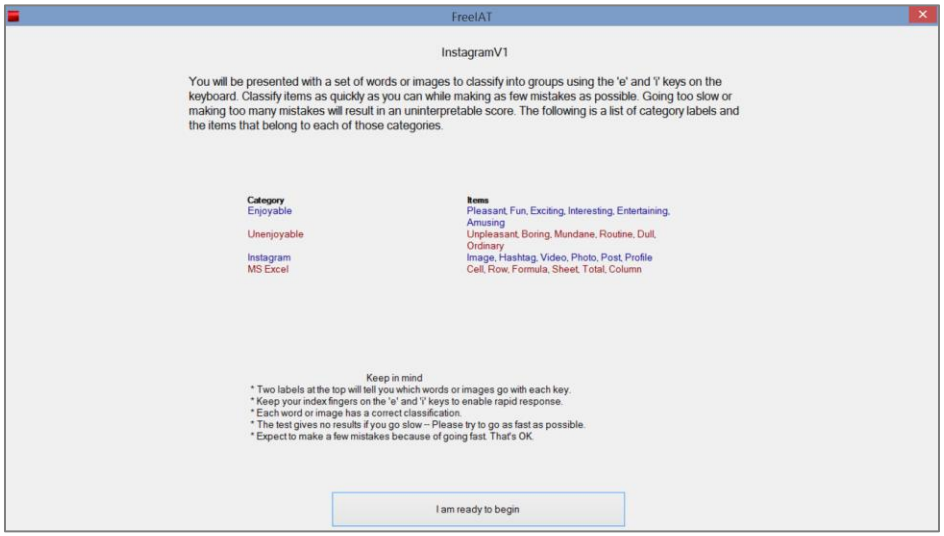


Figure 11. *Free*IAT – Built-in Instructions

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 – 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 recommended by Greenwald et al. (2003). The latter file contains ready-to-use, calculated data (see Figure 12). In this output, there are three ready-to-use values of interest to IS researchers: the overall GNB score calculated based on all stimuli (the first entry: 0.3374), referred to as GNB; the GNB score calculated based on the first half of the stimuli (the seventh entry: 0.3252), referred to as GNB1; and the GNB score calculated based on the second half of the stimuli (the eighth entry: 0.3496), referred to as GNB2. A positive GNB score indicates positive, a zero score – neutral (i.e., but not a lack of implicit attitude), and a negative score – negative implicit attitude. When multiple subjects complete the test on the same machine, their scores are stored in the same output file marked by their ID.

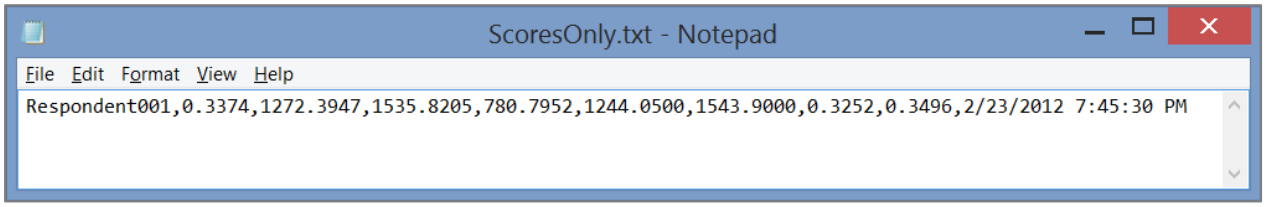


Figure 12. *Free*IAT – ScoresOnly.txt

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 calculating 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 where there is a noticeable difference between the values. In our experience, most GNB scores range from 0 to 2.0, with some occasionally going as high as 2.5, and we have never observed a score exceeding 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 the red flag and should be removed 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% (Oppenheimer, Meyvis, & Davidenko, 2009), and IS researchers admit that it is acceptable to remove up to 10% of all unreliable entries (James et al., 2017). Based on our experience, between 5 to 10% of IAT results many be potentially eliminated from the final dataset.

GNB1 and GNB2 scores may be employed as two reflective indicators in Structural Equation Modelling (SEM) software packages, for instance, in Partial Least Squares (PLS) (e.g., see Serenko & Turel, 2019). Another approach is to 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 analysis, etc. (e.g., see Turel & Serenko, 2020).

If administering 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., no adjustment is needed). However, when Block 3 (where the target construct and the attribute are congruent) and Block 5 (where the target construct and the attribute are incongruent) are rotated (i.e., in this case, Block 3 employs an incongruent pair, and Block 5 employs a congruent pair), the sign of the GNB score should be changed. 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 adjustment of the sign of the GNB scores, however, in versions 3 and 4, the sign of the GNB scores must be changed. For example, Respondent008 completed IAT version 3, and his or her scores should be recorded as: 0.4456 (GNB); 0.4264 (GNB1); and 0.4648 (GNB2) (see Figure 13), and the same adjustment should be done for version 4.

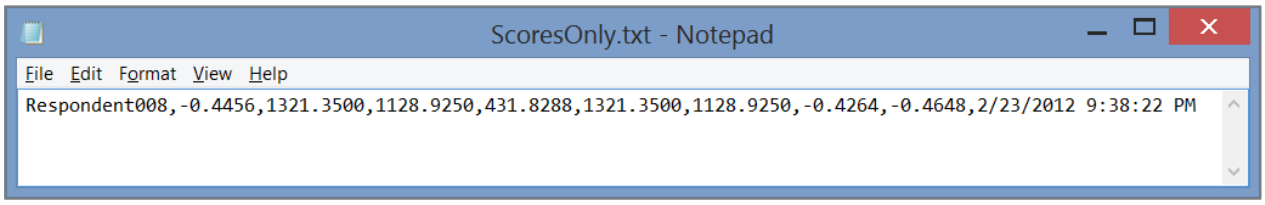


Figure 13. *Free*IAT – ScoresOnly.txt – Version 3

6 Conclusion

A number of IS scholars have already confirmed the potential usefulness and importance of subconscious mental processes, yet, more empirical and theoretical progress is needed. We believe that implicit attitude is a valid and important concept in IS research with the potential to influence subconscious user states and automatic behaviors. Future fruitful applications of the IAT in IS research may include addressing various questions, for example,

- 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 post-adoptive behaviors?
- Is implicit attitude toward a system related to the innovative use of this IT?
- Does implicit attitude toward the IT profession influence students' career choices? If so, can it be modulated through information sessions for incoming students?
- What is the role of implicit attitude in the development of technology addiction?

The IAT may also help scholars address neuro-IS questions, such as whether specific brain regions are associated with a stronger implicit attitude toward an IT, and whether neuro-modulation techniques, for example, transcranial direct current stimulation, can alter implicit attitude toward an IT. The opportunities are virtually limitless.

In this tutorial, we discussed the concept of implicit attitude and demonstrated its measurement in order to help IS researchers go beyond explicit, conscious attitudes and concepts in their research, and address questions such as the ones stated 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 is "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) ranging from abstract concepts (e.g., hacktivism) to concrete examples of information systems (e.g., MS Word). In most cases, attitude is a complex construct which consists of 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 composed of individual attributes.

People, however, 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). The decomposition of an overall attitude into a number of attributes has become a common technique in management research; identifying salient dimensions of customer attitude toward a product or service is frequently employed in market segmentation (Hughes, 1971). Such attitudinal attributes, for instance in evaluating automobiles, may include economy, reliability, style, comfort, safety, etc. – each of these attributes is usually considered and contributes to the overall attitude to a different degree. At the same time, it is possible that attitude toward some objects or concepts (such as stand-up comedy) is virtually unidimensional because a single attribute (such as entertainment) completely dominates the person's belief system.

The line of reasoning above may be applied to attitude objects in the IS domain – IS attitude objects consist of 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 its primary function is the facilitation of 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 cognitive, affective, and behavioral aspects of IS users.

In the implicit association test, 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.Assessment of Construct and/or Attribute – 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 B2. 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 re-start 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

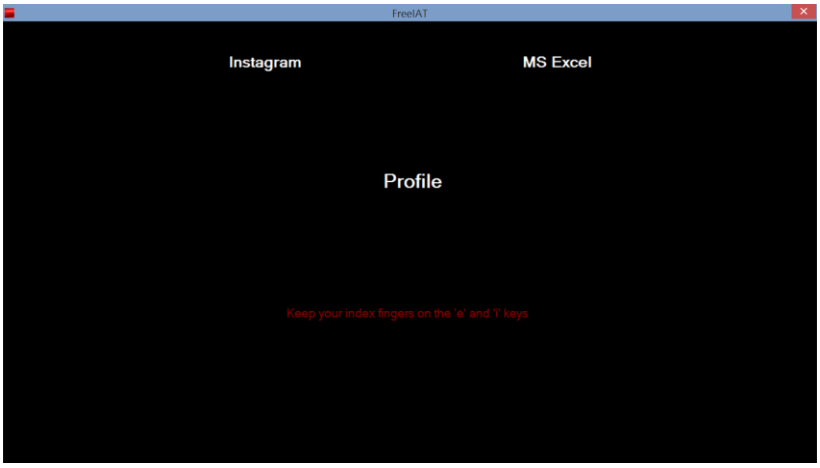
Please note:

- 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. Items belong 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.

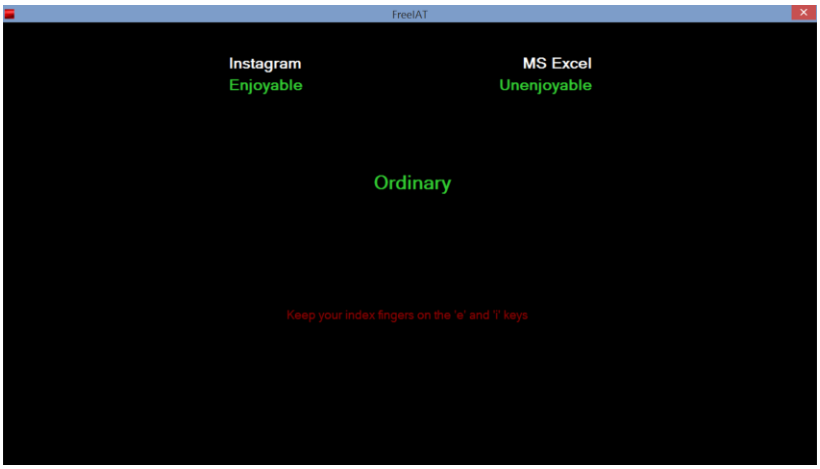
The entire experiment includes five blocks.

Block 1. You will see two categories, e.g., *Instagram* vs. *MS Excel*. 20 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.

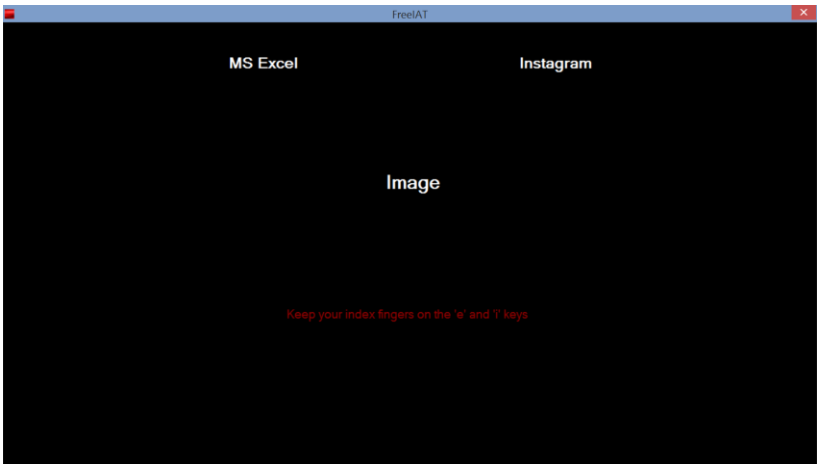


Block 2. You will see two new categories e.g., *Enjoyable* vs. *Unenjoyable*. Again, you will need to sort 20 items into categories as fast and accurately as you can.

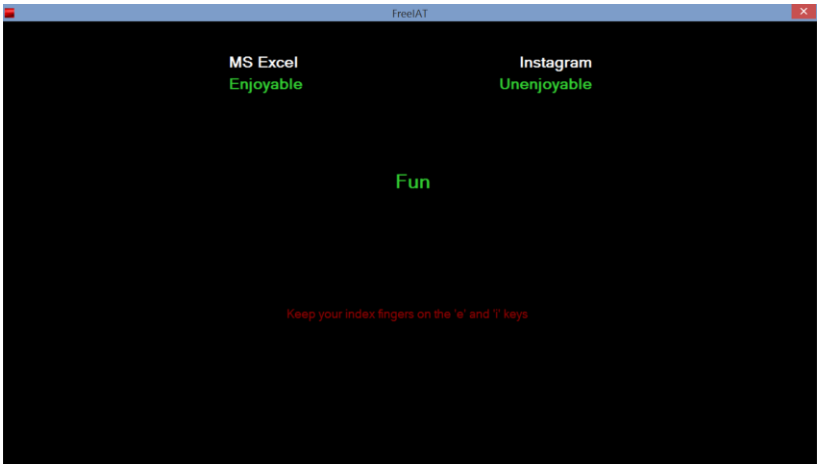
Block 3. Here, the categories you saw earlier will be combined, e.g., *Instagram* + *Enjoyable* vs. *MS Excel* + *Unenjoyable*. You will need to sort 40 items into categories as fast and accurately as you can.



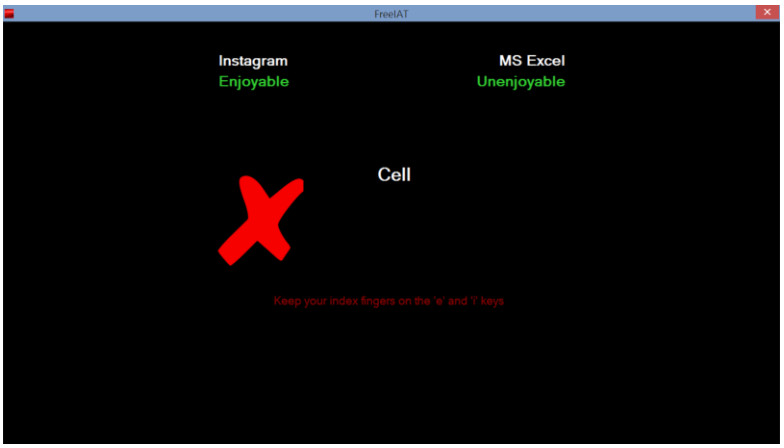
Block 4. Here, the categories have switched their position. The rules, however, are the same.



Block 5. Here, the combined categories have switched their position. The rules, however, are 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, using the “E” and “I” keys, items as per the table below.

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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