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Implicit Social Cognition Through the Years: The Implicit Association Test at Age 21

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Implicit measures allow for the indirect investigation of psychological constructs by measuring the automatic associations between evaluative dimensions and attitude objects. Among these implicit measures, the Implicit Association Test (IAT; Greenwald et al., 1998) is one of the most studied and used. Despite the existence of many literature reviews on the IAT and the constructs it assesses, none of them provides information on the spread of its use in different fields of application. This literature review is aimed at filling this gap by providing an overview on the use of the IAT from the year of its first introduction until today. The main fields of application of the IAT, the specific topics for which it has been used, and its concurrent use with other implicit measures are highlighted and described. The results indicate the growing use of the IAT in ever wider and more varied range of fields.

Keywords: implicit social cognition, implicit association test, implicit measures, attitude measurement

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The idea that people's behaviors, attitudes, and social judgments can be influenced by processes automatically activated by triggering stimuli (i.e., automatic processes) has been widely recognized (Greenwald & Banaji, 2017, Greenwald & Lai, 2020). The investigation of these processes has earned its own label of "implicit social cognition" (Greenwald & Banaji, 1995), and it has attracted the attention of researchers for its potentiality of assessing psychological constructs without relying on people's introspection. The so-called implicit measures have been introduced for this aim. Among them, the Implicit Association Test (IAT; Greenwald et al., 1998) is one of the most widely used. Its better psychometric properties in comparison to those of other implicit measures (e.g., Bar-Anan & Nosek, 2014) and its ease of adaptation for investigating a broad range of topics have surely contributed to its popularity and use among different disciplines (e.g., Greenwald et al., 2009; Zogmaister & Castelli, 2006). The aim of this literature review is to provide a detailed overview of the use of the IAT across fields of applications throughout the past 2 decades.

Does the "Implicit = Unconscious" Equation Hold?

By the end of the nineteenth century, the discussion on consciousness fostered the foundation of psychology as a discipline. The exploration of mental states outside of people's awareness (i.e., the unconscious) and the way to access them were at the center of the debate. In the past 2 decades, the unconscious has been also investigated through the study of automatic associations between evaluative dimensions and attitude objects (Greenwald & Banaji, 1995, 2017, Greenwald & Lai, 2020).

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The data set containing all selected articles and their coding is available in the Open Science Framework repository (https://osf.io/r94fg/).

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Originally, automatic associations were taken to be the behavioral expression of implicit attitudes, which were defined as "introspectively unidentified—or inaccurately identified—traces of past experience that mediate favorable or unfavorable feelings, thoughts, or actions toward social objects" (Greenwald & Banaji, 1995, p. 8). As such, the assessment of automatic associations would allow for inferring the implicit attitudes of the respondents. The IAT and other implicit measures have been deliberately developed for this purpose (Greenwald et al., 1998).

The term *implicit* originally referred to constructs lying beyond people's awareness and consciousness, which could not be accessed by overtly asking individuals to report them (Greenwald & Banaji, 1995). Throughout the years, the construct validity and the nature of the processes assessed via the IAT have been subject to much critique (e.g., Schimmack, 2021). As the use of implicit measures has grown and spread among different fields of application, researchers wondered about the implications for the consciousness of the term implicit and the use of automatic associations for investigating unconscious psychological constructs has been called into question. A few years after the introduction of the IAT, Fazio and Olson (2003) challenged its claim of providing an assessment of unconscious constructs. Requiring more time to associate attitude objects with positive or negative attributes does not necessarily imply that the respondents are unaware of their positive or negative attitudes toward these objects. However, since the respondents are not directly asked to report their feelings and attitudes toward the attitude objects, they might be unaware that their attitudes are being assessed. Consequently, the equation "implicit = unconscious" appears too bold, and unless further evidence in favor of the unconsciousness of the construct is available, implicitly assessed constructs and unconscious constructs should be clearly distinguished (Fazio & Olson, 2003).

In this sense, the distinction between implicit and explicit should be based on the measures used for the assessment and not on the nature of the construct itself. In explicit (direct) assessments, respondents are overtly and directly asked to think about their mental states and to report them, while in implicit (indirect) assessments, the construct is inferred from the respondents' performance at categorization tasks, without asking them for a verbal report or for introspection. The IAT provides an indirect assessment of constructs that are not necessarily unconscious. Evidence in favor of this interpretation of implicit can be found in the poor ability of the IAT to predict behaviors, particularly when compared to that of explicit measures (e.g., Epifania et al., 2020b; Meissner et al., 2019; Perugini, 2005).

The Empirical Meaning of Implicit

The implications for the consciousness of the measure provided by the IAT have been also recently reconsidered by one of its original authors, Anthony G. Greenwald (Greenwald & Banaji, 2017; Greenwald & Lai, 2020). Along with Fazio and Olson (2003), Greenwald and Banaji (2017) considered the lack of evidence for sustaining the unconsciousness of the constructs assessed by the IAT. What the IAT does is assessing without asking. As argued above, this does not allow for claiming that respondents are unaware of their own attitudes. As such, Greenwald and Banaji (2017) endorsed the empirical meaning of implicit and explicit based on the type of assessment, either direct (explicit) or indirect (implicit). Worth noting, the empirical definition of implicit and explicit in Greenwald and Banaji (2017) seems to be in contrast with their previous conceptual definition, in which implicit was equated with the unconscious component of psychological constructs, and explicit was equated with the conscious one. The previous position of these two authors can also be recognized in the title of one of their works, namely *Blindspot: Hidden biases of good people* (Banaji & Greenwald, 2013). Relying completely on the type of assessment, this implicit–explicit distinction could be seen as a "theory uncommitted definition" (Greenwald & Lai, 2020, p. 421), which allows for going beyond the debate on the implications for the consciousness of the term implicit (Greenwald & Lai, 2020). Even though the use of the term implicit in the sense of indirect assessment has become most prominent, the original implications of the term for the unconsciousness should not be forgotten. The first studies using the IAT were aimed at assessing implicit (unconscious) attitudes, not at implicitly (indirectly) assessing attitudes. While this difference has important theoretical implications, the IAT and other implicit measures have been used in the same manner both by those standing for the indirect nature of the assessment and by those advocating the unconscious nature of the

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psychological construct (Greenwald & Lai, 2020). The new currently shared position refers to the term implicit to indicate indirectly assessed constructs (e.g., Brownstein et al., 2019; Greenwald & Banaji, 2017; Greenwald & Lai, 2020).

The discussion on the nature of the constructs assessed by the IAT has already been addressed in other literature reviews (e.g., Brownstein et al., 2019; Greenwald & Banaji, 2017; Greenwald & Lai, 2020). Brownstein et al. (2019) extensively discussed the conscious versus unconscious nature of the constructs assessed by the IAT as well as their situational versus individual nature. Greenwald and Banaji (2017) provided an exhaustive argumentation on the distinction between implicit and explicit that brought to their new conceptualization of implicit as indirect. This new conceptualization was further stressed in Greenwald and Lai (2020).

On the Use of the IAT Throughout the Years

Although the abovementioned reviews provide different perspectives on the most thriving issues regarding implicit measures, a more basic yet useful review quantifying the use of the IAT in different fields of application is missing. The current article aims to fill this gap by providing an overview of the spread of use of the IAT. As such, this work might be of interest not only to researchers who commonly employ the IAT for their studies but also to those who have never used implicit measures but want to. The former ones will find a thorough summary of IAT use across different fields of application over the last 2 decades. The latter ones will find useful information for ascertaining whether their research interests are in line with previous applications of the IAT or whether their aims can be better pursued with other implicit measures or different approaches. Such topics as the implications of the term implicit in the assessment of psychological constructs, the psychometric properties of the IAT, and the nature of the constructs captured by the measure itself are not addressed here. The reader interested in these topics is referred to Brownstein et al. (2019), Greenwald and Banaji (2017), Greenwald and Lai (2020), and Schimmack (2021). Following the current and generally shared conceptualization of implicit (e.g., Brownstein et al., 2019, Fazio & Olson, 2003, Greenwald & Banaji, 2017, Greenwald & Lai, 2020), this review uses the term implicit in its empirical meaning of indirect assessment.

The structure of the IAT and its functioning are briefly outlined in the next section. The listing of criteria for searching, filtering, and classifying the documents follows. Then, the main findings obtained from the selected documents are presented and discussed.

The Implicit Association Test

The IAT is a computerized task aimed at assessing the strength of automatically activated associations between two contrasting attitude objects (e.g., *Flowers* and *Insects* in a *Flowers-Insects* IAT) and two evaluative dimensions (*Good* and *Bad* attributes). It is based on the speed and accuracy with which prototypical exemplars (appearing sequentially at the center of the screen) of the abovementioned categories (displayed at the top corners of the screen) are sorted in the category to which they belong by means of two response keys.

Usually, the IAT is composed of seven blocks (Greenwald et al., 2003). The first two blocks are single-categorization blocks, and they are used as pure practice blocks to let the respondents familiarize themselves with the task and the stimuli. In the first block, the exemplars of the object categories (e.g., *Flowers* and *Insects*) are sorted in the category to which they belong by means of two response keys. In the second block, the exemplars of the evaluative dimensions *Good* and *Bad* are assigned to their own categories by using the same response keys as in the previous block. The third and fourth blocks compose one of the two IAT associative conditions. The labels of the categories *Good* and *Flowers* share the same side of the screen, and the exemplars belonging to these categories are mapped with the same response key. Likewise, the labels identifying the categories *Bad* and *Insects* share the opposite side of the screen, and the exemplars belonging to these categories are sorted with the opposite response key. The fifth block is a practice block, in which the labels of the categories *Insects* and *Flowers* have switched their position on the top sides of the screen. The sixth and seventh blocks compose the contrasting associative condition of the IAT. The categories *Good* and *Insects* share the same side of the screen, and their exemplars are sorted with the same response key. The categories *Bad* and *Flowers* share the opposite

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side of the screen, and their exemplars are categorized with the opposite response key. The order of presentation of the two associative conditions (here identified with blocks three and four, and blocks six and seven) is randomized across respondents.

The IAT rests on the assumption that the categorization task is easier (i.e., responses are expected to be faster and more accurate) in the condition consistent with the automatically activated associations of the respondents. Sticking with the *Flowers-Insects* IAT, the task is supposed to be easier in the condition where *Flowers* and *Good* exemplars share the same response key and *Insects* and *Bad* exemplars share the opposite response key than in the contrasting one. The difference in the performance of the respondents between the two associative conditions is known as the IAT effect. The strength and direction of the IAT effect are usually expressed by means of the *D* score—that is, an effect size measure computed by dividing the difference between the average response times in the two conditions by the standard deviation computed on the pooled trials of both conditions. The algorithms for the computation of the *D* score are described in Greenwald et al. (2003). Different open-source resources are available for the computation of these algorithms, including an R package (i.e., implicitMeasures, Epifania et al., 2020a) and a point-and-drop web application (Epifania et al., 2020c).

Method

To investigate the spread of the studies that employed the IAT, the following search string was entered in the Scopus database:

```
((TITLE-ABS-KEY ("implicit association test") OR TITLE-ABS-KEY ("IAT")) AND

(LIMIT-TO (DOCTYPE, "ar") AND PUBYEAR > 1997 AND LIMIT-TO (DOCTYPE, "re"))

AND (LIMIT-TO (LANGUAGE, "English")))
```

We searched for all documents including either "implicit association test" or "IAT" within their titles, abstracts, or keywords (search option "Title, Abstracts, Keywords"). The search was limited to articles or reviews published in English from 1998 (the year in which the IAT was published for the first time) until the day of the search (October 25, 2019). No filter in the "subject area" search option was applied to get information on IAT use in other disciplines besides psychology. A comma separeted values (CSV) file containing author names, Digital Object Identifiers (DOIs), titles, keywords, and abstracts was downloaded from Scopus.

Articles were excluded if they met at least one of the following criteria: (a) being a literature review, a meta-analysis, a commentary, an editorial, or a book chapter; (b) not having an abstract; or (c) using the acronym "IAT" to identify something different from the Implicit Association Test.

All authors of the present literature review read the titles, abstracts, and keywords of all the articles left after the application of the exclusion criteria listed above. Based on their own reading, the authors individually and independently defined the macro-areas of investigation that describe the main field of application of the article. After completing their own reading of the titles, abstracts, and keywords of all articles, the authors discussed the macro-areas and identified five macro-areas: *social psychology*, *clinical and personality psychology*, *addiction*, *food*, and *marketing*. The macro-area *social psychology* included all studies aimed at investigating attitudes toward different social groups (e.g., African Americans, obese people), their creation and change, regardless of the context, and/or sample on which they were carried out. Studies focused on the assessment of personality traits, both functional (e.g., self-esteem, Big-Five) and dysfunctional (e.g., personality disorders as in Axis II of the Diagnostic and Statistical Manual of Mental Disorders-DSM) and mood disorders as in Axis I of the DSM, which define the macro-area *clinical and personality psychology*. The macro-area *addiction* included all studies on addiction, regardless of the type (e.g., alcohol, smoking, denoted in the specific topic), the sample, and the context in which they were carried out. Studies assessing food preference and perception, as well as of the attitudes toward dieting, composed the macro-area *Food*, and studies investigating brand characteristics, brand preferences, and brand and labeling perception composed the macro-area *marketing*. The authors reached a substantial consensus on the definition of the five macro-areas and on of the articles did not fit well in any of the five macro-areas and agreed that new macro-areas created *ad hoc* for classifying these articles would

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have been too specific and narrow. Therefore, the authors decided to collect all these articles into the macro-area *other*, which includes studies on varied topics, such as perception, methodology, law, and criminal justice. The six macro-areas were then partitioned in specific topics related to the general purpose of the articles. For instance, in the macro-area *social psychology,* the specific topic identified the objects of the attitude assessment.

Information on the implicit measure(s), on the samples, and on the use of physiological measures [e.g., electroencefalogram (EEG), transcranial direct-current stimulation (tDCS), functional magnetic resonance imaging (fMRI)] were retrieved from the titles, abstracts, and keywords as well. The label "Not in title/abstract/keyword" was used when the information was not retrievable.

The CSV file downloaded from Scopus was imported in `R` (R Core Team, 2018). The abstracts of the selected articles were used to prepare a text corpus via the `tm` package (Feinerer et al., 2008). A word-cloud was obtained from the text corpus by using the `wordcloud` package (Fellows, 2018). Other graphical representations were made with the `ggplot2` package (Wickham, 2016).

For each macro-area, the median for the grouped frequencies of the specific topics was computed. In the tables throughout the article, the specific topics are arranged in decreasing order.

Results and Discussion

The search resulted in 3,467 documents. In 1,546 of these documents, the string "IAT" was used as acronym of something different from the Implicit Association Test, such as Internet Addiction Test (e.g., Cacioppo et al., 2019), Island Arc Tholeiites (e.g., Yang et al., 2020), or Intra-Arterial Thrombectomy (e.g., Lee et al., 2019). Thus, these studies were excluded from the analysis. Of the remaining 1,921 documents, 113 were excluded because of one of the following reasons: they did not have an abstract ($n = 7$); they were a review ($n = 47$), a meta-analysis ($n = 9$), a commentary ($n = 35$), an editorial ($n = 1$), an essay ($n = 1$), an addendum ($n = 1$); or they cited the IAT but did not actually use it ($n = 1$). Moreover, 11 documents were excluded because their abstracts did not provide enough information. A total of 1,808 documents were left for inspection. The resulting document pool included an article from 2020 (after the search date) in which the IAT was used. This document was excluded from the analysis. The results presented in the following sections are based on a document pool of 1,807 articles. The titles, abstracts, and keywords of these articles were individually read by each author of the present literature review.

To prepare the text corpus for the word-cloud, the authors first removed all English stop words from the abstracts (e.g., "the," "this"). The words were manually stemmed to produce the word-cloud and to compute the measures of associations between the terms. These measures were expressed by a correlation coefficient resulting from their co-occurrences across the abstracts. Following the theoretical definition of implicit used in this study, the term "implicit" included all the derivatives of the word (e.g., "implicitly") as well as the word "indirect" and its derivatives. The term "explicit" included all the derivatives of the word (e.g., "explicitly"), the words denoting a specific type of explicit assessment (e.g., "rating"), as well as the word "direct" and its derivatives. However, words referring to the conscious nature of the psychological constructs, such as "conscious" and "unconscious," were left apart as distinct terms.

To make the word-cloud more readable, only the terms with a frequency of at least 120 occurrences were plotted. The word-cloud obtained from the abstracts of the articles is depicted in Figure 1.

Figure 1
Word-Cloud Obtained From the Abstracts of 1,807 Articles



Note. The bigger the font, the higher the frequency.

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The terms that appeared most frequently in the abstracts were "IAT" (n = 1,512 abstracts), "implicit" (n = 1,395 abstracts), "investigation" (n = 1,184 abstracts), and "measure" (n = 1,156 abstracts). The term "explicit" appeared in 988 abstracts. The term "IAT" only correlated with the term "score" (r = .10). The correlation between the terms "implicit" and "explicit" was moderate (r = .33), suggesting that the concurrent administration of direct and indirect measures of the same construct is quite common. The term "implicit" also correlated with the terms "attitude" (r = .19), "measure" (r = .15), and "self-esteem" (r = .10), suggesting that implicit measures are often used for the investigation of self-esteem. The term "investigation" was weakly associated with more than 10,000 terms, with correlations ranging from .07 (e.g., "*implicit*") to .01 (e.g., "*dissatisfaction*"). This result might suggest the expanding use of implicit measures to investigate an extensive range of topics. The term "measure" correlated with both the terms "explicit" (r = .19) and "implicit" (r = .15), and with the terms "validity" (r = .12) and "construct" (r = .12), which possibly indicates that implicit and explicit measures are often administered together to investigate construct validity. The term "measure" also correlated with the terms "attitude" (r = .09) and "predictor" (r = .09). Finally, the term "explicit" correlated with the terms "attitude" (r = .17) and "desirability" (r = .10), suggesting the sensitivity of explicit measures to social desirability when it comes to attitude assessment.

Although the abovementioned search method was specifically aimed at identifying articles using IAT, implicit measures other than the IAT were found, which means their frequency of use is underrepresented. However, the frequency of IAT use with other implicit measures and the frequency of use of modified versions of the IAT are meaningful and can be reasonably interpreted given the search method employed. Table 1 reports the frequency of use of different implicit measures in each macro-area. Overall, the macro-area *social psychology* registered the highest frequency, immediately followed by the macro-area *other*. The macro-areas *clinical and personality psychology* and *addiction* also showed a rather high frequency, while the macro-areas *food* and *marketing* showed the lowest frequencies, with the latter one having the smallest frequency of all.

Given the search method, the only reasonable comparison can be made between the exclusive use of the IAT as a stand-alone measure and its concurrent use with other implicit measures. About 80% of the studies in the macro-areas *social psychology* and *clinical and personality psychology* used the IAT (84.31%, and 79.23%, respectively). The use of the IAT in the macro-area *other* was rather high as well (74.96%). The concurrent use of the IAT with other implicit measures was less than 10% in all macro-areas.

Figure 2 depicts the frequency of use of different implicit measures from 1998 to 2019. The 21 years under consideration are on the x-axis, while the different shades of gray represent the use of just the IAT (IAT only), the concurrent use of the IAT and other implicit measures (IAT and other implicit measures), the use of a modified version of the IAT (Modified IAT), or the use of implicit measures other than the IAT (other implicit measures). The absolute frequencies of use of the abovementioned implicit measures for each year are on the y-axis.

The largest part of articles citing the IAT only used it for implicitly investigating the constructs of interest. The use of modified versions of the IAT was uncommon. Unsurprisingly, in the 4 years after the first publication of the IAT (from 1998 to till 2002), only this measure appeared to be used, with the only exception of 2001, when a modified version of the IAT was employed. From 2008 onward, a steady increase in the concurrent use of the IAT with other implicit measures, as well as the use of measures other than the IAT, occurred.

The next sections comment on the topic trend and use of implicit measures throughout the years. Specifically, distinct sections are dedicated to the IAT as a standalone measure or together with other implicit measures. Additionally, there is a section listing the modified versions of the IAT, but given the low total frequency of their use (n = 16), a detailed description of their applications is not provided. The articles that employed implicit measures other than the IAT are discussed in the Supplemental Material.

IAT Only

The articles in which only the IAT was used totaled 1,418. For these articles, Figure 3 depicts the trend lines of each macro-area of investigation from 1998 to 2019.

The mean trend per year (i.e., the arithmetic mean of the number of articles per year across the

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Table 1
Use of Implicit Measures in Each Macro-Area

Macro-area	Measures					
	IAT only	IAT and other implicit measures	Modified IAT	Other implicit measures	Not in title/abstract/keyword	Total
Social psychology	513	17	2	44	30	604
Other	425	32	10	75	29	571
Clinical and personality psychology	290	23	2	32	19	366
Addiction	113	7	1	34	4	159
Food	43	5	1	9	3	61
Marketing	34	1	0	3	8	46
Total	1,418	85	16	197	91	1,807

Note. Not in title/abstract/keyword: It was not possible to retrieve the exact implicit measures employed from the title/abstract/keyword. IAT = Implicit Association Test.

six macro-areas) is represented by the dashed line, and it indicates a growth in the use of the IAT during the past 21 years. All macro-areas seem to follow this trend. Despite some drops in the frequency of IAT use, specifically in 2008, 2013, and 2016, its frequency of use has been growing again for the past few years, with 2019 being the year that registered the highest frequency of use.

The trend lines of the macro-areas *social psychology* and *other* appear always above the average trend line. The trend line of the macro-area *clinical and personality psychology* is the most inconsistent throughout the years. Specifically, this line shows a steady growth until 2007–2008, with a drop in 2009, followed by a vacillating trend until 2015, where a sort of plateau is observed with a final peak in 2019. The trend lines of the macro-areas *food* and *marketing* are similar between each other, both pointing to an increase in IAT use over the past few years.

Table 2 illustrates the most common samples employed in articles using IAT only. More information on the specific samples can be found in the Supplemental Materials.

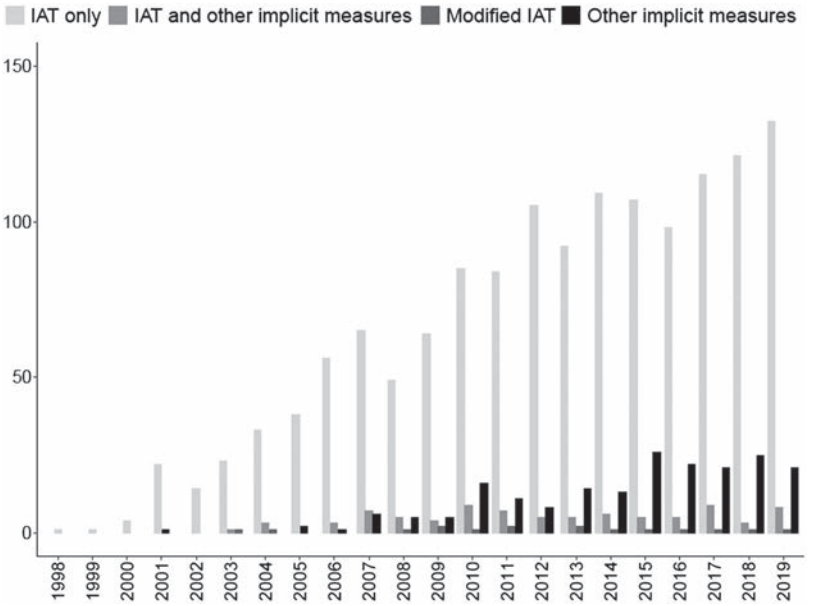
The samples that were not identifiable from the titles, abstracts, and keywords (n = 707, composing almost half of the samples—49.86%—in the only IAT applications) have been excluded from Table 2. The discussion on the samples is aimed at being neither exhaustive nor conclusive but rather to give an overview of the IAT applications among different populations. Comments on the employed samples for each macro-area are given in the corresponding subsections.

The IAT in the Macro-Area Social Psychology

The IAT applications for the investigation of a broad range of specific topics in the macro-area *social psychology* were the most frequent ones. It was possible to identify 25 specific topics to classify the 513 articles of this macro-area. All articles investigating attitudes toward different outgroups and/or minority groups, regardless of the context and outgroups, were included in this macro-area. Table 3 illustrates the frequency of the IAT applications for the investigation of each specific topic in this macro-area.

The median computed on the cumulated frequencies of each specific topic was 256.50. As such, 50% of the articles in this macro-area were included in the first two specific topics

Figure 2
Frequency of Use of Different Implicit Measures From 1998 to 2019



(i.e., outgroup prejudice and stereotypes, gender studies).

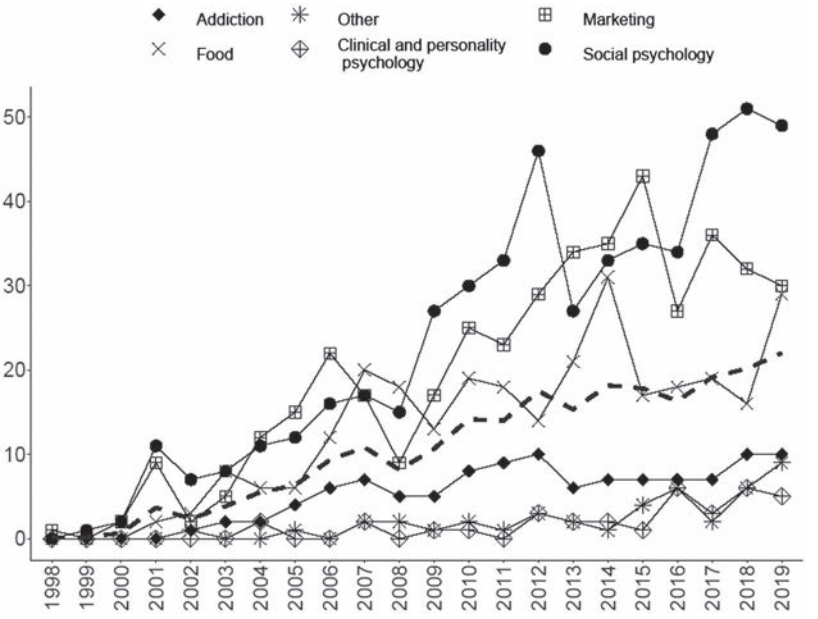
Most of the articles dealt with the investigation of outgroup stereotypes and prejudice, specifically related to racial prejudice. Articles on gender stereotypes followed, although there was a large gap in the number of applications in respect to the previous ones. The third most common applications of the IAT in this macro-area were for the investigation of *illness-related attitudes*, including the assessment of attitudes toward people with either mental impairments or physical disabilities ($n = 30$), psychiatric patients ($n = 23$), people with HIV ($n = 2$), cancer patients ($n = 2$), general patients ($n = 1$), and suicide survivors ($n = 1$). Other common applications pertained to the assessment of weight bias, attitudes toward Lesbian Gay Bisexual Transgender Queer Intersex Asexual + (LGBTQIA+) individuals, political preference, and ageism. Despite having a lower frequency, the IAT was also used to assess attitudes toward people professing different religions, toward non-native English speakers, and toward people with low incomes. Articles composed of multi-studies investigating the attitudes toward multiple outgroups (e.g., outgroup prejudice and weight bias) were common. The IAT was also used to investigate topics related to the Stereotype Content Model (SCM; Fiske et al., 2002), including infra-humanization, and to investigate the effectiveness of experimental manipulations to change/induce attitudes, even toward fictious groups.

As it can be seen from Table 2, the IAT has been widely used among samples composed of hospital personnel (e.g., doctors, nurses, therapists), adults, undergraduate students, teachers, and work personnel (e.g., CEOs, hiring personnel, university boards).

The common goal of the articles investigating outgroup prejudice and stereotypes, illness-related attitudes, and weight bias among hospital personnel was to understand whether the bias toward one of the specific outgroups influenced the quality of the provided care or the probability of suggesting a specific surgery. In a similar vein, the IAT was applied on samples composed of work personnel. These articles aimed to understand whether the attitudes toward one of the outgroups could undermine the probability of the outgroup members to be hired in a corporation or to win a position in academia. Another interesting application of the IAT was for the investigation of outgroup prejudice or gender stereotypes of teachers. These studies aimed to understand whether teachers' gender attitudes

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Figure 3
Trend Lines of Each Macro-Area of Investigation in Documents Using Only the IAT From 1998 to 2019



Note. IAT = Implicit Association Test.

(e.g., associating males with math and females with humanistic subjects) or their racial attitudes (e.g., associating European-American children with higher intelligence than non-European-American children) could indirectly influence their behaviors toward the pupils.

The IAT in the Macro-Area Clinical and Personality Psychology

Table 4 reports the occurrences of each specific topic of the macro-area *clinical and personality psychology*. Twenty-five specific topics were identified to classify the 290 articles in the macro-area *clinical and personality psychology*.

The median computed on the cumulated frequencies was 145. As such, the first four specific topics in Table 4 included 50% of the articles in this macro-area. The IAT was mostly used for the implicit assessment of self-esteem, while other common specific topics were related to the assessment of personality traits (e.g., Big Five personality traits) and anxiety. The psychological disorders of Axes I and II of the DSM were also fairly well investigated. The IAT was also commonly used for the implicit assessment of suicidal tendencies, aggressiveness, emotions, and clinical sex behavior (e.g., pedophilia).

The most common samples used in this macro-area were composed of clinical patients (see Table 2). The applications among undergraduate students, adolescents, adults, criminals, women, and children were rather common as well.

The IAT in the Macro-Area Addiction

Table 5 reports the occurrences of the 10 specific topics used to classify the articles in this macro-area.

The median of the cumulated frequencies was 56.50. As such, the first specific topic (i.e., alcohol) already included 50% of the articles in this macro-area. Most articles in this macro-area were focused on the investigation of alcohol addiction followed by articles on nicotine and smoking addiction, although there was a large gap between these two specific topics. The concurrent investigation of multiple addictions, such as drinking and smoking or drinking and gambling, was uncommon as was the investigation of all other specific topics, such as cocaine addiction.

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Table 2
Samples Used in Studies Employing Only the IAT

Samples	Social psychology	Other	Clinical and personality psychology	Addiction	Food	Marketing	Total count
Undergraduate students	55	39	23	29	2	0	148
Adults	58	23	13	12	4	4	114
Patients	5	16	64	17	2	1	105
Hospital personnel	62	7	0	1	0	1	71
Female	9	9	18	0	3	0	39
Children	20	4	9	3	0	0	36
Other	12	9	9	1	4	0	35
Adolescents	4	2	17	8	0	0	31
Web	13	2	2	0	0	0	17
Criminals	1	3	10	0	0	0	14
Teachers	13	0	1	0	0	0	14
Work personnel	10	3	0	0	0	0	13
Male	3	6	3	0	0	0	12
Cross cultural	4	2	3	0	2	0	11
Heavy drinkers	0	0	0	11	0	0	11
Athletes	0	2	3	3	0	0	8
Drug users	0	1	0	5	0	0	6
Autistic	1	4	0	0	0	0	5
Children dyad	3	0	0	0	0	0	3
Couples	1	1	1	0	0	0	3
Fitness people	2	1	0	0	0	0	3
Families	0	1	1	0	0	0	2
Gamers	0	1	1	0	0	0	2
Multiple	0	0	1	1	0	0	2
Old people	1	0	1	0	0	0	2
Reanalysis	1	1	0	0	0	0	2
Animals	0	1	0	0	0	0	1
Gamblers	0	0	0	1	0	0	1

Note. IAT = Implicit Association Test.

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Table 3
Specific Topics of the Macro-Area Social Psychology

Specific topic	*n*	Specific topic	*n*
Outgroup prejudice and stereotypes	205	Colonial mentality	2
Gender	65	Group identification	2
Illness related	59	Internal stigma	2
Weight bias	41	Stereotypes creation	2
Mixed social	22	Drug addicts	1
LGBTQIA+ individuals	21	Feminism	1
Politics	20	Inclusion	1
Ageism	19	Independence	1
Religiosity	12	Powerful individuals	1
Language	11	Smokers	1
Poverty	8	Tattooed individuals	1
SCM	8	Veterans	1
Attitude change/ creation	6		

Note. LGBTQIA+ = Lesbian Gay Bisexual Transgender Queer Intersex Asexual +; SCM = Stereotype Content Model (Fiske et al., 2002). In this application, the SCM label includes also studies on infra-humanization.

Most of the articles for which it was possible to retrieve the samples from the titles, abstracts, or keywords (Table 2) were carried out on undergraduate students, adults, patients with a diagnosis of addiction, and heavy drinkers.

The IAT in the Macro-Area Food

The 43 articles included in the macro-area *food* were classified into nine specific topics. Most articles in this macro-area investigated the preference for different kinds of food in general ($n = 20$) or the preference for un/healthy food ($n = 14$). These two specific topics included 50% of the articles in this macro-area. Two articles investigated implicit attitudes toward dieting, and two articles investigated food perception. The remaining articles investigated a broad range of topics, including the willingness to eat insects (Verneau et al., 2016). Food craving, food self-control, and the effect of the time of day on food preference were investigated as well. In one study, it was not possible to retrieve the specific topic from the abstract. The majority of the samples in this macro-area were not retrievable from the titles, abstracts, or keywords.

Table 4
Specific Topics of the Macro-Area Clinical and Personality Psychology

Specific topic	*n*	Specific topic	*n*
Self-esteem	72	Attachment	5
Personality	32	Self-concept	5
Anxiety	26	Affect	2
Axis I and Axis II Disorders (DSM)	23	Disgust sensitivity	2
Suicidal tendencies	19	Impulsiveness	2
Aggressiveness	17	Mixed clinical	2
Emotions	16	Burnout	1
Clinical sex behavior	12	Cognitive bias	1
Self-evaluation	12	Sense of guilt	1
Self-harm	10	Intelligence	1
Body perception	9	Resilience	1
Eating disorders	9	Shyness	1
Phobias	9		

Note. DSM = Diagnostic and Statistical Manual of Mental Disorders. This label includes both personality and mood disorders.

The IAT in the Macro-Area Marketing

The 34 articles in the macro-area *marketing* were classified into 18 specific topics. Fifteen of these topics, such as the perception of credit card use and the perception of luxury goods, showed a frequency of one study each. The median computed on the cumulated frequencies was 17. The first three specific topics, namely brand preference ($n = 10$), decision-making in products purchasing ($n = 5$), and perception of products packaging ($n = 4$), included 50% of the articles in this macro-area. In most cases, it was not possible to retrieve the samples on which the studies were carried out from the titles, abstracts, or keywords.

The IAT in the Macro-Area Other

This macro-area included articles on a broad and extensive range of topics, from gender perception of odds and even numbers (Wilkie & Bodenhausen, 2015) to work-related stress (Klein et al., 2012), romantic attachment (Zayas & Shoda, 2005), and validation and formal

Table 5
Specific Topics of the Macro-Area Addiction

Specific topic	*n*	Specific topic	*n*
Alcohol	69	Heroin	4
Smoking	16	Gambling	3
Mixed addiction	6	Marijuana	3
Technology related	5	Coffee	2
Doping	4	Cocaine	1

Note. The label *Technology related* includes social network and smartphone pathological use.

modelling of the IAT. The 425 articles in this macro-area were classified into 131 specific topics. Eighty-one of these topics (61.83%) presented a frequency of one study each. Given the high number of specific topics with an occurrence of one, they are not only reported in Table 6 but can also be found in the Supplemental Materials.

The median computed on the cumulated frequencies was 212.50; 50% of the articles in this macro-area fell within the first 10 specific topics in Table 6. Most of the articles were aimed at the validation of the IAT, followed by studies on perception and studies on methodology. The distinction between the specific topics *Measure validation* and *Methodology* is quite subtle. The former includes articles aimed at the validation of the IAT procedure (e.g., Greenwald et al., 1998) and its scores (e.g., Greenwald et al., 2003) as well as investigating the factors that may influence the IAT effect (e.g., Bluemke & Friese, 2006). The latter includes articles in which existing formal models were used for modeling the IAT data, such as the application of the Many-Facet Rasch Measurement Model (Linacre, 1960) in Anselmi et al. (2011) or the application of the Diffusion Model (Ratcliff, 1978) in Klauer et al. (2007). Articles aimed at the validation of *ad-hoc* models for the IAT data, such as the Quad Model (Conrey et al., 2005) or the Discrimination-Association Model (Stefanutti et al., 2013), are included in the specific topic *Methodology* as well.

Table 6
Specific Topics of the Macro-Area Other

Specific topic	*n*	Specific topic	*n*
Measure validation	48	Health	3
Perception	38	Legal psychology	3
Methodology	28	Reactions to *D-score*	3
Autobiographical	23	Safety	3
Not in title/abstract/ keywords	21	Sex orientation	3
Sex behavior	15	Abnormal social behavior	2
Physical activity	13	Achievement tendencies	2
Environmental concern	9	Aesthetic judgment	2
Religion	9	Autism	2
Faking	8	Avoidance	2
Connection with nature	7	Body language	2
Morality	7	Death	2
City perception	6	Forgiveness	2
Road safety	6	Implicit motives	2
Violence	6	Leadership	2
Beliefs	5	Learning	2
Face perception	5	Loneliness	2
Identification	5	Motivation	2
Risk	5	Music	2
Attitudes toward technology	4	Perception of other	2
Need for cognition	4	Partner	2
Stress	4	Romantic attachment	2
Work environment	4	Sense of ownership	2
Cultural topics	3	Sounds perception	2
Eye gaze	3	Time of day	2

The IAT appeared to be fairly well used for investigating human perception, such as the preference for symmetrical over asymmetrical patterns and fake memories. Fake memories are mostly investigated via the autobiographical IAT (Agosta et al., 2011). Besides the specific topics that were not identifiable from the titles, abstracts, or keywords, the IAT was commonly employed for investigating sex behaviors, such as attitudes toward safe sex, and physical activity. The frequencies reported in Table 6 clearly indicated a growth in IAT use to investigate a wider range of specific topics. In most cases, the specific samples were not identifiable.

IAT and Other Implicit Measures

A total of 85 studies using the IAT together with other implicit measures were selected. The Single Category IAT (SC-IAT; Karpinski & Steinman, 2006) and the Single Target IAT (ST-IAT; Wigboldus et al., 2004) are similar procedures, and the terms SC-IAT and ST-IAT are often used interchangeably. Thus, the authors considered the SC-IAT and the ST-IAT together. Table 7 reports the occurrence of IAT use together with other implicit measures.

The IAT was mostly used with the SC-IAT/ST-IAT, the Affective Misattribution Procedure (AMP; Payne et al., 2005), and the Implicit Relational Procedure (IRAP; Barnes-Holmes et al., 2006). The concurrent use of the IAT with another implicit measure was most common in the macro-area *other*. The macro-areas *clinical and personality psychology* and *social psychology* followed. The joint application of implicit measures in other macro-areas was uncommon.

Regarding the applications in the macro-area *other*, the majority of the studies were aimed at validating the implicit measure used concurrently with the IAT (i.e., the measure obtained from the IAT was used as a criterion for assessing the validity of the other implicit measure).

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Table 7
Frequency of Use of the IAT With Other Implicit Measures in Each Macro-Area

IAT with	Other	Clinical and personality psychology	Social psychology	Addiction	Food	Marketing	Total
SC-IAT/ST-IAT	5	5	1	1	1	0	13
AMP	4	2	4	0	1	1	12
IRAP	2	3	5	0	1	0	11
AMP + Other	6	0	2	1	0	0	9
EAST	2	1	1	2	2	0	8
APT	4	0	1	1	0	0	6
GNAT	2	0	3	0	0	0	5
More than 2	2	3	0	0	0	0	5
NLT	0	4	0	0	0	0	4
AAT	0	1	0	1	0	0	2
EPT	1	0	0	1	0	0	2
AIP	0	0	1	0	0	0	1
DPT	1	0	0	0	0	0	1
NLPT	0	1	0	0	0	0	1
PAT	0	1	0	0	0	0	1
SPF	1	0	0	0	0	0	1
Stroop	0	1	0	0	0	0	1
TAT	0	1	0	0	0	0	1
WRT	1	0	0	0	0	0	1
Total	31	23	18	7	5	1	85

Note. IAT = Implicit Association Test; SC-IAT/ST-IAT = Single Category IAT/Single Target IAT; AMP = Affective Misattribution Procedure (Payne et al., 2005); IRAP = Implicit Relational Procedure (Barnes-Holmes et al., 2006); AMP + Other = Studies using IAT, AMP, and another implicit measure; EAST = Extrinsic affective Simon task (De Houwer, 2001); APT = Affective priming task (Fazio et al., 1995); GNAT = Go/no-go association task (Nosek & Banaji, 2001); More than 2 = Studies using IAT and more than 2 other implicit measures; NLT = Name Letter Task (Kitayama & Karasawa, 1997); EPT = Evaluative priming task (Fazio et al., 1986); AAT = Approach avoidance task; AIP = Action inference paradigm (Banse et al., 2010); DPT = Dot probe task; NLPT = Name letter preference task (Nuttin, 1985); PAT = picture association task (van Leeuwen et al., 2013); SPF = Sorting paired features task (Bar-Anan et al., 2009); TAT = Thematic apperception test; WRT = Word recognition task (Hayes et al., 1999).

Perception was often investigated with the conjoint use of the IAT and other implicit measures as well (see Gast & De Houwer, 2012; Van Dessel et al., 2019; van Leeuwen et al., 2013). Given the broad variability of the specific topics investigated with the conjoint use of the IAT and other implicit measures, all the details are reported in the Supplemental Materials and are not discussed here.

The concurrent use of the IAT and the SC-IAT was most common in the macro-area *clinical and personality psychology*. This combination was mostly used for investigating self-esteem, aggressiveness, anxiety, and personality traits. Other popular combinations of implicit measures in this macro-area were the ones with the Name Letter Task (NLT; Kitayama & Karasawa, 1997) and the IRAP, which were mostly used to investigate self-esteem and suicidal tendencies.

In the macro-area *social psychology*, the most common combination of implicit measures was the one with the IRAP. The use of the IAT with the AMP and the use of the IAT with the Go/no-go association task (GNAT; Nosek & Banaji, 2001) were rather common as well. In this macro-area, fewer common combinations of the IAT were with the SC-IAT, Extrinsic affective Simon task (EAST), and Affective priming task (APT).

In the macro-area *addiction*, the IAT was mostly used with the EAST, the Approach avoidance task (AAT), and the SC-IAT.

Modified IAT

Only 16 articles reported the use of modified versions of the IAT. These include the Palm IAT (Dabbs et al., 2003), the Personalized IAT (Olson & Fazio, 2004), the Paper & Pencil IAT (Mori et al., 2008), the Recoding Free IAT (Rothermund et al., 2009), the Audio IAT (McKay et al., 2010), the Flanker IAT (Soderberg & Sherman, 2013), the Questionnaire-Based IAT (Yovel & Friedman, 2013), the motivational Recoding Free IAT (Kraus & Scholderer, 2015), and the odors and feelings IAT (Lemercier-Talbot et al., 2019).

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Final Remarks

This literature review provides a general yet informative overview of the use of the IAT across different fields and highlights a growing trend in its applications for the investigation of a broad and varied range of topics. Interestingly, the applications of the IAT throughout the years have extended from the typical applications in social cognition to applications in other fields, such as marketing, perception, and sex behaviors.

The first result that stands out is that most studies using the strings "Implicit Association Test" or "IAT" in their titles, abstracts, or keywords investigate social psychology-related topics, regardless of the specific outgroup, context, and/or sample on which they were carried out. Among them, racial prejudice is the most investigated one. Studies on gender stereotype, weight bias, bias toward LGBTQIA+ individuals, and attitudes toward people with mental illness or physical pathologies and disabilities are also fairly well investigated, particularly in sensitive contexts, such as hospitals and organizations. *Clinical and personality psychology* is another popular field of application of the IAT, with self-esteem being the most investigated topic in this field. Many applications assessed personality and mood disorders according to the classification criteria in Axes I and II of the DSM. The investigation of suicidal tendencies, especially in samples of adolescents, also resulted in a thriving field of investigation in this macro-area. The macro-areas *food* and *marketing* have seen considerable recent growth in IAT use.

In this literature review, the only reasonable comparison between the frequency of IAT use and of other implicit measures was between the IAT as a standalone measure and its combined use with another implicit measure. The IAT appeared to be used mostly with the SC-IAT, and the AMP. However, the IAT appears to be used more often as a standalone measure than together with other implicit measures. This could suggest that the measure provided by the IAT is usually considered as a valid indirect assessment of the construct under investigation.

The data collected for this review can be employed as a starting point for further investigations regarding IAT use and its applications. The abstracts (made available online and as Supplemental Materials) can be screened by readers, who can pinpoint further and more specific subjects of interest. For example, starting from the data set provided, an investigation on the concurrent use of implicit and explicit measures in one of the identified macro-areas can be carried out. Another interesting future research direction might focus on the specific use of implicit measures to address theoretical questions on consciousness and automatic processes.

The six macro-areas have been independently identified by the authors of this literature review by reading the titles, abstracts, and keywords of the articles. These macro-areas could be taken to be sufficiently homogeneous within them and heterogeneous between them to classify the selected articles and to provide an exhaustive overview of the applications of the IAT in different fields. Despite a substantial consensus between the authors on the macro-areas, their definition presents a subjective component that can influence the results and their interpretation. Alternative criteria might have been used to identify the macro-areas and to assign the articles to them, such as considering the names of the journals. However, this strategy might have generated undesired effects. Take for instance the article by Klauer et al. (2007) on the application of the Diffusion Model to the IAT. This article deals with the feasibility of the Diffusion Model for the analysis of the IAT data as well as the theoretical meaning and implications of the estimated parameters. Grounding the classification on the journal name, this article would have been assigned to a macro-area referring to either *social psychology* or *personality psychology*, hence misinterpreting the actual aim of the article. We pointed out that the IAT is used in an always wider and more varied range of fields. It is plausible that this result is largely unaffected by the specific criteria used for classifying the articles.

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