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Universidad de Almería
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Measuring Adolescents’ Smoking-related Social Identity Preferences with the Implicit Relational Assessment Procedure (IRAP) for the First Time: A Starting Point that Explains Later IRAP Evolutions

Nigel Vahey*1, Shawn Boles2 and Dermot Barnes-Holmes1
1National University of Ireland Maynooth, Maynooth, County Kildare, Ireland
2Oregon Research Institute, Eugene, Oregon USA

ABSTRACT

This preliminary study is the first to illustrate the conceptual rationale for, and methodological potential of, an Implicit Relational Assessment Procedure designed to measure adolescents’ smoking-related social identity preferences (SIP-IRAP). Even with a small sample comprising of eight adolescent smokers and eight nonsmokers, the IRAP data tentatively suggested that adolescent smokers have a tendency to relate the sample word ‘Smoker’ as “Similar” to social acceptance words, but adolescent nonsmokers do not. The IRAP further distinguished smokers from nonsmokers by their tendency to relate ‘Nonsmoker’ as ‘Similar’ to social rejection words. The current study, in its presentation of an uncomplicated “preparation-IRAP” for participants to rehearse before taking the SIP-IRAP, constitutes the earliest attempt to optimise participant performance on the original IRAP methodology. Given that the raison d’etre of the IRAP is to continually optimise experimental control over the measurement of verbal biases, we use the current study as a basis for explicating the chronology and evolving rationale for subsequent evolutions of the IRAP methodology currently entering the literature. A central aim of our account is to use IRAP first principles to collate and interpret such recent optimisations of the IRAP methodology, in order to recommend how best to use the IRAP in future investigations probing the verbal networks of adolescent smokers. The current preliminary study particularly emphasized the importance for optimising the precision of the IRAP, of using adjunctive participant preparation procedures. The current paper suggests how with optimizations, the IRAP is likely to provide additional predictive utility over self-report measures for adolescents, particularly when applied to relatively stigmatized or impulsive behaviours.

Key words: Adolescents, Implicit Relational Assessment Procedure, smoking, social identity, Relational Frame Theory.

RESUMEN

Este estudio preliminar es el primero en ilustrar la lógica conceptual y el potencial metodológico de un procedimiento implícito de evaluación relacional (Implicit Relational Assessment Procedure) para medir las preferencias de identidad social relacionada con el consumo de tabaco de los adolescentes (SIP-IRAP). A pesar de un pequeño tamaño muestral, con ocho fumadores y ocho no fumadores, los datos de IRAP sugieren que los adolescentes fumadores tienen una tendencia a relacionar la palabra ‘Smoker’ como ‘Similar’ a las palabras de aceptación social, pero no los no fumadores. El IRAP distingue a los fumadores de los no fumadores por su tendencia a relacionar ‘Nonsmoker’ como ‘Similar’ a las palabras de rechazo social. El estudio actual, que presenta una forma sencilla de “rehearsal-IRAP” para que los participantes practiquen antes de tomar el SIP-IRAP, constituye el primer intento de optimizar el desempeño de los participantes en la metodología original del IRAP. Dado que el propósito del IRAP es optimizar el control experimental sobre la medición de las bias verbales, utilizamos este estudio como base para explicar la cronología y el razonamiento evolutivo para las futuras evoluciones de la metodología del IRAP que actualmente entran en la literatura. Un objetivo central de nuestra cuenta es utilizar los principios del IRAP para collate y interpretar tales optimizaciones recientes de la metodología del IRAP, en orden a recomendar cómo mejor utilizar el IRAP en futuras investigaciones que prueben las redes verbales de fumadores adolescentes. El estudio preliminar actual particularmente enfatizó la importancia de optimizar la precisión del IRAP, utilizando procedimientos de preparación del participante. El presente artículo sugiere cómo con optimizaciones, el IRAP es probablemente capaz de ofrecer una utilidad predictiva adicional sobre las medidas de autoinforme para adolescentes, particularmente cuando se aplica a comportamientos relativamente estigmatizados o impulsivos.

Key words: Adolescentes, Implicit Relational Assessment Procedure, consumo de tabaco, identidad social, Relational Frame Theory.
Procedure diseñado para medir las preferencias de identidad social relacionadas con el hábito de fumar en adolescentes (SIP-IRAP). Incluso con una muestra reducida compuesta por ocho fumadores y ocho no-fumadores, los datos del IRAP sugerieron de manera tentativa que los fumadores adolescentes tienden a relacionar la palabra de muestra “Fumador” como “Similar” a términos indicativos de aceptación social, mientras que los adolescentes no fumadores no mostraron esta tendencia. El IRAP permitió diferenciar aún más entre fumadores y no fumadores por la tendencia de los primeros a relacionar “No fumador” como “Similar” a términos de rechazo social. Este estudio, al incluir un IRAP de preparación bajo en dificultad para que los participantes ensayasen de manera previa a la realización del SIP-IRAP, es el primer intento de optimizar la actuación de los participantes con la metodología original del IRAP. Dado que la razón de ser del IRAP es la optimización continua del control experimental en la medición de sesgos verbales, se emplea el presente estudio como base para explicar la cronología y la lógica en el desarrollo de las posteriores evoluciones metodológicas del IRAP que están apareciendo en la literatura en la actualidad. Uno de los objetivos centrales de este trabajo es utilizar los principios iniciales del IRAP para revisar y explicar estas optimizaciones recientes de la metodología IRAP, de cara a establecer la mejor manera de utilizar el IRAP para investigar las redes relacionales verbales en adolescentes fumadores. Este estudio preliminar pone especial énfasis en el uso de procedimientos complementarios de preparación de los participantes para aumentar la precisión del IRAP. Este trabajo sugiere que con las modificaciones adecuadas es probable que el IRAP permita obtener validez predictiva adicional sobre los procedimientos de autoinforme en adolescentes, especialmente cuando se evalúen comportamientos impulsivos o socialmente estigmatizados.

Palabras clave: adolescentes, procedimiento de evaluación de relaciones implícitas, fumar, identidad social, Teoría de los Marcos Relacionales.

A host of changes in early adolescence increases concern about the self and provides new catalysts for engagement in potentially harmful behaviours, such as smoking and alcohol use. As early adolescents enter middle or junior high school, they experience changes in the organization and teaching practices of schools, which decrease social support from adults, break up the social networks formed in elementary school, and contribute to increased teasing and harassment from peers (Eccles et al., 1993). These conditions, especially the emergence of new social groups, appear to contribute to a decrease in academic performance (Chung, Elias, & Schneider, 1998; Gutman & Midgley, 2000), loss of interest in school (Midgley, Feldlaufer, & Eccles, 1988; Wigfield, Eccles, Yoon, & Harold, 1997), decreases in perceived academic and social competence and self-esteem (Anderman, Maehr, & Midgley, 1999; Wigfield & Eccles, 1994), and increases in general psychological distress (Chung et al., 1998). Some evidence suggests adolescents’ experimentation with risky or unhealthy behaviours may arise from these difficulties as attempts are made to cope with their newly developing social situation by gaining kudos from new peers (Biglan, Brennan, Foster, & Holder, 2004). Indeed, with respect to tobacco use, several studies point to the social influence of peer relationships and role models as primary factors precipitating, and then supporting tobacco dependence (Gordon, Biglan, & Smolkowski, 2008; Kobus, 2003; Song, Ling, Neilands, & Glantz, 2007; Tickle, Hull, Sargent, Dalton, & Heatherton, 2006).
In broad outline, we know that the above-described challenges of early adolescence are associated with lower self-esteem, increased concerns about social acceptance, and the initiation of a variety of problems. However, there is little information about the specific ways in which adolescent cognitions about social identity and problem behaviours influence the actual prevalence of those problem behaviours. A core difficulty of conducting such research with adolescents is that their verbal behaviour concerning problem behaviours is prone to sources of stimulus control that influence self-report measures in confounding or unpredictable ways (cf. Adams, Parkinson, Sanson-Fisher, & Walsh, 2008; Dolcini, Adler, & Ginsberg, 1996; Greisler, Kandel, Schaffran, Daly, & Hu, 2008). For example, imagine if a young adolescent male were asked to indicate how strongly he agreed that teenagers who smoke tobacco were “cool” versus “uptight”. Insofar as the question is perceived to be coming from a respected “authority” figure, such as a teacher or researcher, it is possible that a relatively anti-smoking response would be forthcoming. Alternatively, if the adolescent is inclined to present himself as a “bad boy”, an exaggerated pro-smoking response may be offered. Indeed, the involvement of relatively complex variables in determining such verbal responses may undermine the individual’s ability to produce verbal behaviour about their own smoking that is uncontaminated by audience control, or other social variables. One possible way of removing, or at least reducing, the influence of such extraneous variables is to minimize the amount of time available for each response.

The assumption here is that audience or other social variables need time to influence a response, and thus relatively rapid responding is less contaminated by such variables (Barnes-Holmes, Barnes-Holmes, Stewart, & Boles, 2010). This assumption lies at the core of a family of computerised response time measures designed to measure so-called implicit attitudes. Implicit measures all seek to capture attitudinal biases before they are obscured by the bifurcating deliberative processes underlying self-reported attitudes. At their core, all measures of implicit cognition seek to do this using a similar general methodological strategy: all require the rapid categorization of various stimulus objects, such that easier more familiar categorization tasks (i.e. allowing faster responding) are compared with complementary categorization tasks that are less familiar and thus more difficult (i.e. necessitating slower responding). If, for a given implicit measure, a participant completes a categorization task more quickly than its complementary comparison task, then the extent of this response time difference is always taken as an index of the strength of the implicit attitude being measured; how we interpret the specific meaning of that implicit attitude is characterized by the nature of the contrast defined between the particular pair of categorization tasks being juxtaposed.

The Implicit Association Test (IAT; Greenwald, McGhee, & Schwartz, 1998), is the most popular implicit measure; it characterises implicit attitudes in terms of relative associations among two overarching evaluative concepts (e.g. “Positive” versus “Negative”) and two descriptive categories (e.g. pleasant objects such as flowers, versus conventionally unpleasant things such as insects). More specifically, on each trial of the IAT the participant is required to sort a stimulus into one of four categories using just two response keys; each response key simultaneously symbolises one of the IAT’s two evaluative concepts and one of the IAT’s two descriptive categories. The core as-
The assumption underpinning the IAT is that individuals should respond quickly to the extent that the evaluative category and the descriptive category sharing each response key are closely associated in the participant’s memory; participants should respond more slowly to the extent that the evaluative and descriptive categories sharing each response key are dissociated in the participant’s memory.

The first IAT study, by Greenwald et al. (1998), asked participants in one task to categorize the names of flowers with positive words and the names of insects with negative words, but in a second task these categorizations were reversed (flowers-negative and insects-positive). The predicted IAT effect was observed; the participants responded faster on flower-positive and insect-negative trials than on the reversed counterparts. The assumption here, of course, was that flowers are positive and insects are negative for most people. Numerous subsequent studies have replicated this basic finding across a wide range of domains (see Nosek, Greenwald, & Banaji, 2006, for a recent review), and most controversially the IAT effect has often been found in socially sensitive areas such as racism (e.g., Dasgupta, Greenwald, & Banaji, 2003).

A number of IAT studies have examined smoking-related implicit attitudes (e.g., De Houwer, Custers, & De Clercq, 2006; Sherman, Rose, Koch, Presson, & Chassin, 2003; Swanson, Rudman, & Greenwald, 2001; Waters, Carter, Robinson, Wetter, Lam, & Cinciripini, 2007). However, to date, only two IAT studies have examined the relationship between implicit and explicit smoker identity, and smoking behaviour (Dal Cin, Gibson, Zanna, Shumate, & Fong, 2007; Swanson et al., 2001); together they suggest that implicit associations of self with smoking predict smoking status. Indeed, Dal Cin et al. (2007) provided evidence specifically for the interaction of peer influences and implicit smoking identity in precipitating smoking behaviours: greater self-reported identification of adolescents with role models in movies who smoke predicted greater implicit identification of self with smoking (among both smokers and nonsmokers), and increased intention to smoke (among smokers). However, the findings of Swanson et al. (2001) and Dal Cin et al. (2007) are equivocal because the basic architecture of the IAT necessitated that associations of self with smoking were not measured in their own right, but relative to a vague contrast category labelled ‘unspecified other’ (i.e., ‘they,’ ‘them,’ and ‘other’). De Houwer et al. (2006), Karpinski (2004), and Robinson, Meier, Zetocha, and McCaul (2005), among others, have remonstrated directly about this, underlining how changing the contrast category of an IAT results in qualitatively different smoking-related implicit preferences being indicated. For example, Swanson et al. (2001) found smokers exhibited pro-smoking implicit attitudes when stealing was used as a contrast concept category for ‘Smoking,’ but expressed antismoking attitudes when sweets were used as a contrast category.

De Houwer (2002) asserts more generally that these interpretative difficulties arise from a fundamental methodological limitation of the IAT: it measures only the relative strength of an association between two descriptive concepts. The IAT cannot capture the directionality of the evaluative association between descriptive concepts (i.e. their relation), nor detect associations between attributes and each descriptive concept individually. For example, if an IAT effect indicates that participants respond more quickly when flower is paired with positive and insect with negative than vice versa, this result could
reflect a range of different attitudes: it could indicate that flowers and insects are both liked, but flowers are liked more than insects, or it could indicate that both flowers and insects are disliked but insects are disliked more than flowers. The relativistic measure of associative strength provided by the IAT therefore lacks experimental control over what it is intended to measure: the IAT tasks are simply not well specified enough to allow a clear interpretation of which particular evaluative bias it is indexing. In other words, participants are free to interpret each IAT task in a variety of different ways, so that the IAT effect is strengthened or weakened by many unobserved extraneous factors.

A rapidly emerging behaviour analytic alternative, the Implicit Relational Assessment Procedure (IRAP; Barnes-Holmes et al., 2006), seeks to provide a means of overcoming such interpretative difficulties suffered by the IAT, by exceeding the level of experimental control achieved by previous implicit methodologies (Barnes-Holmes, Barnes-Holmes, Stewart, & Boles, 2010; Barnes-Holmes, Hayden, et al., 2008). In particular, by targeting individual stimulus relations rather than relativistic associative response biases, the IRAP is able to disentangle verbal biases about smokers and non-smokers as distinct social identities, and so the method may provide an opportunity to extend the previous work reported by Swanson et al. (2001) and Dal Cin et al. (2007).

In essence, the IRAP is a computerized task that contrives a situation experimentally whereby it is possible to detect differences in the fluency of pairs of mutually exclusive relational response classes using response latency performances. Specifically, half of the IRAP tasks are designed to require participants to provide relational responses consistent with their behavioural histories, with the other half requiring history-inconsistent relational responses. For example, participants might be asked to respond “True” to the statement “Smoker is similar to Cool” on half of the trials but respond “False” on the other half; the prediction being that a smoker will respond “True” more quickly than “False” on this task to the extent that their behavioural history coheres with this pattern of responding.

More formally, the Relational Elaboration and Coherence (REC) model (Barnes-Holmes, Barnes-Holmes, Stewart, & Boles, 2010; Cullen, Barnes-Holmes, Barnes-Holmes, & Stewart, 2009) provides a behaviour-analytic explanation for such differences in response fluencies on the IRAP. According to the REC model, the more a class of prescribed IRAP responses corresponds and coheres with the participant’s predominant history of relational responding in everyday life, the fewer covert relational responses will be involved in producing the first overt relational response measured by the IRAP. To the extent that an overt response prescribed by the IRAP is preceded by fewer covert relational responses it then follows, all things being equal, that these overt responses will be produced more quickly (Barnes-Holmes et al., 2010; Barnes-Holmes, Hayden et al., 2008; O’Toole & Barnes-Holmes, 2009). For example, a person with a history of strong fear of spiders should be quicker to make IRAP responses affirming that spiders are “dangerous” (deemed consistent) than to make IRAP responses denying this (deemed inconsistent).

Therefore, according to the REC model the relative fluency of consistent versus inconsistent responses (i.e. the IRAP effect) constitutes a behavioural bias that indicates the extent to which an individual is inclined toward affirming one belief versus its inverse.
Conversely, if there is no response time difference between consistent and inconsistent responses this suggests the beliefs being assessed bear little relevance to the individual’s verbal history. Thus the verbal bias indexed by the IRAP effect provides a guide as to how frequent such verbal behaviour is likely to be in the future. From this perspective the IRAP effect is more similar to the original conception of attitudes as behavioural biases, than it is to more recent conceptualizations of attitudes as internalized mental constructs that are relatively removed from behaviour (cf. Fazio & Petty, 2008).

In light of the foregoing, we conducted a preliminary study to explore the potential of the IRAP as an implicit measure of smoking-related social identity preferences (i.e., the SIP-IRAP). More specifically, the SIP-IRAP examined the relationship of the sample concepts ‘Smoker’ and ‘Nonsmoker’, to social acceptance words associated with smoking in tobacco-company marketing campaigns (National Cancer Institute, 2008). We wanted to examine how smoking status is associated with young adolescents’ verbal networks about the social standing of smokers and nonsmokers, paying particular attention to how teens identify ‘tobacco industry words’ about social acceptance with Smokers or Nonsmokers. As alluded to earlier, when young people have experienced social difficulties, they may be motivated to think of themselves as tough and/or popular (Moos, 2006). This in turn could motivate adolescents to try smoking, as it would enable building a relational network in which they would be associated with the valued attributes attached to smoking by tobacco advertisements and peers (Biglan, 2004; Gordon et al., 2008). In a rough way, such a hypothesis has long been in the literature (e.g., Chassin, Presson, & Sherman, 1990). We therefore hypothesized that adolescent smokers would relate the sample word ‘Smoker’ as “Similar” to social acceptance words like those contained in tobacco company advertisements, but that nonsmokers would not.

Then, given that the inception of the IRAP was due to a desire to continually optimise experimental control over the measurement of verbal biases, the current IRAP study also sought to optimise the original IRAP (Barnes-Holmes et al., 2006), by pilot ing the first adjunctive procedure designed to enhance the experimental control achieved by the original IRAP.

Achieving greater experimental control with the REC model. It follows by implication of the REC model that in order to minimise contamination of the IRAP by extraneous deliberative influences, two aspects of a participant’s behaviour must be controlled:

- overt relational responding must be constrained in terms of a well-defined belief of interest, by encouraging participants to maintain only consistent relational responses during consistent IRAP trials, and only inconsistent relational responses during inconsistent IRAP trials;
- participants should be induced to complete their prescribed IRAP responses as quickly as possible, so that the covert relational responding that precedes each overt IRAP response is minimally contaminated by extraneous covert verbal behaviour.

In summary, the precision of the IRAP effect as a measure of verbal biases will increase, to the extent that the relationships measured by the IRAP are well-defined, and precision will increase the faster these prescribed IRAP responses are completed.
correctly. However, the original formulation of the IRAP, although more well-defined than the IAT in terms of the high specificity of the attitudes it targeted, nonetheless went no further than the IAT in terms of ensuring that participants responded as quickly and accurately to its tasks as possible (i.e. participants were merely encouraged to respond quickly and accurately, and no formal response time or accuracy criteria were required of participants; Barnes-Holmes et al., 2006; Barnes-Holmes, Hayden, et al., 2008; Cullen et al., 2009; McKenna, Barnes-Holmes, Barnes-Holmes, & Stewart, 2007; Power et al., 2009a). Instead, the developers of the IRAP took an incremental empirical approach towards the optimisation of the experimental control wielded by the IRAP.

The particular approach taken in the current study toward optimising the original IRAP was to precede the SIP-IRAP, with a brief and simplified “preparation-IRAP” designed to familiarize participants with the generic procedural features of the IRAP. By familiarising the participants with the generic features of the IRAP, we sought to facilitate faster and more accurate responding among participants on the subsequent SIP-IRAP. Given that the current study constitutes the earliest such attempt to optimise the IRAP methodology, we use it as a basis for explicating the chronology and evolving rationale for subsequent evolutions of the IRAP methodology currently entering the literature.

**Method**

**Recruitment and Participants**

Staff recruited participants via invitations given to students at a local alternative school, via informational flyers, and via invitations to participants in focus groups conducted in conjunction with ongoing studies at the Center on Early Adolescence at Oregon Research Institute. Students who indicated an interest in taking part received an information packet that included a flyer describing the study, a parental consent form, an adolescent assent form, and a brief screening questionnaire to determine smoking status. This screening questionnaire asked the volunteers three questions:

- During the past 30 days, on how many days did you smoke cigarettes? (options: 0 days; 1 or 2 days; 3-5 days; 6-9 days; 10-19 days; 20-29 days; All 30 days);
- Do you want to stop smoking cigarettes completely? (options: Yes; No; I do not smoke now);
- Do you think you will be smoking cigarettes one year from now? (options: Yes; Maybe; Definitely Not).

Volunteers were included in the study as smokers if they reported smoking at least 5 of the last 30 days and that they don’t want to quit smoking (incidentally, all smokers answered either yes or maybe when asked whether they would be smoking a year from then). Volunteers were included as nonsmokers if they reported smoking 0 cigarettes in the past 30 days, reported that they don’t smoke, and that they definitely would not be smoking in a year from then.

The study participants were 16 11- to 19-year-old students (8 smokers: \( M_{age} = 15.8 \))
years, \( SD = 1.8 \) years; 8 nonsmoking: \( M = 13.9 \) years, \( SD = 2 \) years) recruited via the process described above. Seven of the participants were female. The sample ethnicity was European American.

**Measures**

The study involved presenting two IRAPs consecutively. The first IRAP, the preparation-IRAP, was presented to participants in order to familiarize them with the generic procedural features of the IRAP. By familiarising the participants with the generic features of the IRAP using the preparation-IRAP, we sought to facilitate faster and more accurate responding among participants on the second IRAP which was designed to measure smoking-related social identity preferences (i.e., the SIP-IRAP).

At the onset of each IRAP trial one *sample stimulus* appeared at the top of the screen, along with one *target stimulus* in the middle of the computer screen, with the two responses options appearing respectively at the bottom left and right of the screen (the left-right positions of the response options interchanged randomly among trials). Both of the IRAPs involved two sample stimuli, two classes of target stimuli, and two response options. For each IRAP, there were four possible combinations of a sample stimulus with a target stimulus class, and each combination defined one of that IRAP’s four different trial-types. IRAPs are designed so that for each trial-type, the participant’s choice between the two available response options constitutes a choice between two relational responses: one *consistent* with the target population’s behavioral history and one *inconsistent* with that behavioral history. As a fundamental feature of all IRAPs:

- half of the IRAP trials *required* participants to provide relational responses *consistent* with their behavioral history,
- and the other half *required* participants to provide corresponding *inconsistent* relational responses contradicting that behavioral history.

In those cases where participants provided a key-press response other than that prescribed, these *incorrect* responses caused display of a red ‘X’; and to proceed to the next trial the participant had to provide the *correct* response (as determined by whether the trial occurred in a consistent versus inconsistent block). After each correct response an inter-trial interval delayed the onset of the next IRAP trial by 400 milliseconds (msec). The accuracy of the first response, and the latency in msec to the first correct response, were both recorded. The critical comparison in calculating the IRAP effect for each trial-type was between the consistent and inconsistent mean response latencies recorded from the trials belonging to that trial-type.

IRAP trials were presented in blocks that were distinguished by whether consistent versus inconsistent responses were required; consistent versus inconsistent blocks were always presented alternate and an equal number of times. At the end of each block of trials the participant was presented with their percentage of correct responses and their median response latency for the preceding block of trials (so as to encourage fast and accurate responding). Each IRAP block, whether consistent or inconsistent, was comprised of a random sequence of all possible pairings of sample and target stimuli.
In other words, each individual member of a target stimulus class was paired once with each of the two sample stimuli in each block of IRAP trials: therefore the number of trials in each IRAP block was equal to four times the number of target stimuli.

However, whereas the preparation-IRAP comprised of two pairs of alternating consistent and inconsistent blocks (i.e. two practice-blocks followed by two test-blocks), the SIP-IRAP comprised of eight such block pairs (i.e. the SIP-IRAP comprised of two practice-blocks, followed by the six test-blocks). The SIP-IRAP’s two practice-blocks were identical, and presented in identical consistent-inconsistent sequence, to those presented in the SIP-IRAP test-blocks. Rather than contributing to the calculation of IRAP effects, the SIP-IRAP practice-blocks were intended to familiarize participants with the specific stimuli used by the SIP-IRAP, with the aim of facilitating fast and accurate responding during subsequent SIP-IRAP test-blocks that was relatively free from the extraneous influence of stimulus novelty.

Between each block of trials the following instructions were presented on screen: “Important: during the next phase the previously correct and wrong answers are reversed. This is part of the experiment. Please try to make as few errors as possible -in other words, avoid the red X.” The following message also appeared immediately before each test-block: “This is a test. Go fast; making a few errors is okay.” After the latency and accuracy feedback for the sixth and final test-block, a message appeared informing the participant that the experiment was complete.

For the SIP-IRAP, participants were assigned randomly to one of two conditions: consistent-first or inconsistent-first. Participants assigned to the consistent-first condition began the SIP-IRAP with a consistent block of trials and thereafter alternated between inconsistent and consistent blocks until the end of the SIP-IRAP; those assigned to the inconsistent-first began the SIP-IRAP with a block of inconsistent trials before similarly alternating between blocks of consistent and inconsistent trials (however due to procedural errors, a quarter of the smokers were not counterbalanced in this way; six of eight smokers were assigned to the inconsistent-first condition). IRAPs are counterbalanced in these ways to mitigate any extraneous conditioning effects that may result from the ordering of consistent versus inconsistent blocks.

However, unlike the SIP-IRAP, the preparation-IRAP was implemented using only a consistent-first block sequence; we reasoned that if participants were at least initially free from the confusing requirement of having to provide relational responses contradicting their behavioral histories (i.e. inconsistent responses), they would be more likely to derive the generic procedural features of the IRAP than otherwise. We chose the preparation-IRAP’s stimuli based on a similar premise: that the participants would find it easier to complete the preparation-IRAP accurately if responses deemed consistent cohered strongly and clearly with their experience, and if inconsistent tasks clearly contradicted their experience. More formally, the preparation-IRAP stimuli were chosen so that consistent relational responses were likely to cohere to a high degree with the behavioural histories all English speaking participants (e.g. the response similar when “pleasant” and “smile”, or “unpleasant” and “vomit”, are presented), and so that inconsistent responses were likely to contrast strongly with participants’ behavioural histories, in a homogenous manner (e.g. the response similar when “pleasant” and
“vomit”, or “unpleasant” and “smile”, are presented). The particular stimuli chosen to this end, emulate the stimuli validated in the first IAT study (Greenwald, McGhee, & Schwarz, 1998), and in the first IRAP studies (Barnes-Holmes et al., 2006; Barnes-Holmes, Hayden, et al., 2008); as a basic initial test of the sensitivity of their respective implicit methodologies, these studies sought to employ stimulus comparisons that would have very familiar and homogenous functions for most people. Table 1 details the response options, two sample stimuli, and two classes of target stimuli, that together fully defined the preparation-IRAP’s four trial-types. The preparation-IRAP therefore involved presenting its four target comparison stimuli within each block of trials twice: each target stimulus once with each of the two sample stimuli in random order (i.e. the preparation-IRAP involved 8 trials per block). Figure 1 illustrates the format in which

Table 1. The Four Stimulus-response Combinations deemed Consistent in the Preparation-IRAP.

<table>
<thead>
<tr>
<th>Sample 1</th>
<th>Sample 2</th>
<th>Response option 1</th>
<th>Response option 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pleasant targets</td>
<td>Unpleasant targets</td>
<td>Similar</td>
<td>Opposite</td>
</tr>
<tr>
<td>Pleasant</td>
<td>Unpleasant</td>
<td>Headache</td>
<td>Vomit</td>
</tr>
<tr>
<td>Laugh</td>
<td>Smile</td>
<td>Unpleasant</td>
<td>Headache</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Vomit</td>
<td>Laugh</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Smile</td>
</tr>
</tbody>
</table>

Note. By implication all of the other four possible stimulus-response combinations are deemed inconsistent.

Figure 1. Examples of the four practice-IRAP trial-types showing responses deemed consistent versus inconsistent.
the four preparation-IRAP trial-types were presented to participants. The dotted arrows
with text boxes superimposed in Figure 1 indicate the responses deemed consistent
(e.g., “Pleasant”-Pleasant Items-Similar) or inconsistent (e.g., “Pleasant”-Pleasant Items-
Opposite); text boxes and arrows did not appear on screen during the experiment.

Figure 2 illustrates the format in which the SIP-IRAP’s four trial-types were present-
ted. The SIP-IRAP’s target stimuli, listed in Table 2, consisted of four social acceptance
words communicated in tobacco advertising (cool, tough, independent, and popular) and
four social rejection words (uptight, needy, weak, and lame). The SIP-IRAP’s eight target
stimuli, when individually combined with each sample stimulus (i.e. “Smoker” versus

![Figure 2](http://www.ijpsy.com)

**Figure 2.** Examples of the Smoker-identity IRAP’s four trial-types showing responses deemed
consistent versus inconsistent.

| Table 2. The Four Stimulus-response Combinations deemed Consistent in the Smoker-
<p>| Sample 1 Acceptance | Sample 2 | Rejection | Sample 1 Rejection | Sample 2 Acceptance |</p>
<table>
<thead>
<tr>
<th>Sample 1</th>
<th>Sample 2</th>
<th>Sample 2</th>
<th>Sample 1</th>
<th>Sample 2</th>
<th>Acceptance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smoker</td>
<td>Cool</td>
<td>Nonsmoker</td>
<td>Uptight</td>
<td>Smoker</td>
<td>Uptight</td>
</tr>
<tr>
<td>Tough</td>
<td>Nonsmoker</td>
<td>Uptight</td>
<td>Weak</td>
<td>Smoker</td>
<td>Uptight</td>
</tr>
<tr>
<td>Independent</td>
<td>Nonsmoker</td>
<td>Weak</td>
<td>Weak</td>
<td>Nonsmoker</td>
<td>Cool</td>
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<tr>
<td>Popular</td>
<td>Needy</td>
<td>Need</td>
<td>Needy</td>
<td>Independent</td>
<td>Uptight</td>
</tr>
<tr>
<td>Response option 1</td>
<td>Similar</td>
<td>Response option 1</td>
<td>Similar</td>
<td>Response option 2</td>
<td>Opposite</td>
</tr>
</tbody>
</table>

**Note.** By implication all of the other four possible stimulus-response combinations are deemed inconsistent.
“Nonsmoker”), meant that there were 16 trials in each of the consistent or inconsistent blocks of trials. We chose the SIP-IRAP’s target stimuli based on an unpublished analysis of tobacco advertising exposure data gathered during the 2003 Oregon Healthy Teens (OHT) Survey (http://www.ori.org/oht/PDFS/GoldE.pdf). In summary, these data indicated that a preponderance of respondents associated themselves with cigarette brands incorporating coolness/popularity or toughness/independence themes. For example, 62% of the non-smoking students and 79% of the smoking students chose either Marlboro or Camel as the brand they would buy if they were to purchase cigarettes; 8th- and 11th-grade students did not differ from one another in these brand choices. These two brands have long incorporated either ‘toughness/independence’ (Marlboro) or ‘coolness/popularity’ (Camel) as core themes in their advertising messages (Biglan, 2004).

Procedure

The participants were assessed either at Oregon Research Institute (ORI) or at the student’s school or home. In the latter two settings, the assessor assured that the testing environment was equivalent to that provided at ORI (i.e., a quiet space free from interruption). Participants were informed that they would be paid US$20 regardless of completion and were permitted to quit at any point in the experiment—none did so.

The assessment began with a paper-and-pencil self-report survey that included questions related to antisocial behaviour; exposure to anti-tobacco information; attitudes toward and actual use of tobacco, alcohol, and other drugs. The researcher then explained what the preparation-IRAP would involve via role play using a set of instructions that illustrated each of its four trial-types. The researcher primarily used the trial-type illustrations to explain the two alternative response rules that the participant would be required to satisfy at speed in order to correctly complete the IRAP (i.e., those deemed consistent versus inconsistent). However, the researcher also used these illustrations to outline the basic block structure of the IRAP for participants (i.e., how many times the response rule would alternate between each block of IRAP trials). Once participants indicated that they understood the researcher’s IRAP instructions they were then given the four blocks of preparation-IRAP trials described above.

At the end of the preparation-IRAP, the researcher asked participants whether they had any further questions about the correct completion of the preparation-IRAP. Having answered any questions, the researcher then presented the second set of instructions illustrating the SIP-IRAP’s four trial-types. Using the same role play approach as taken earlier before the preparation-IRAP, the researcher used the illustrations of the SIP-IRAP to explain the four types of consistent and four types of inconsistent responses that the SIP-IRAP would at different stages require (i.e., two response classes for each trial-type). As with the preparation-IRAP, the researcher encouraged the participant to refrain from stopping during the SIP-IRAP unless they required further instruction on how to avoid the onscreen appearance of a red X. At the end of the SIP-IRAP participants were fully debriefed about the study’s rationale.
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RESULTS

The raw IRAP data comprise response latencies, defined as the time in msec from the onset of a trial to the first emission of that trial’s prescribed response (i.e., consistent versus inconsistent). The critical comparison in calculating the IRAP effect for each trial-type, is between the consistent and inconsistent mean response latencies recorded from the trials belonging to that trial-type. We removed participant datasets with an accuracy of less than 70% across the SIP-IRAP’s test-blocks (n = 3, all smokers), since low accuracy scores indicate lack of reliable experimental control by the IRAP protocol over the participants’ responses (Vahey et al., 2009). The overall mean latencies from the SIP-IRAP across the test-blocks for the remaining five smoker participants were shorter in the Consistent (C) blocks than for the Inconsistent (I) blocks (C = 3862 msec, I = 4450 msec; t(451) = -1.9056, p = .057), but were not for the remaining 8 nonsmokers (C = 3286 msec, I = 3389 msec; t(755) = -.5951, p = .552).

We derived the IRAP effects for each trial-type from the raw response latencies using a technique based on the ‘improved scoring algorithm’ developed for use with the IAT by Greenwald, Nosek, and Banaji (2003; Table 4, p. 214). The D measure is an established means of addressing the general finding that participants with longer average latencies tend to show larger raw effects than those who respond more quickly. Indeed, O’Toole and Barnes-Holmes (2009) found that their raw IRAP effect, the response latency differences between consistent and inconsistent trials, correlated significantly with various measures of intelligence; yet when the D-transformation was performed on the data (not reported in the article) no significant correlations with intelligence were observed. Because the D algorithm largely removes the influence of extraneous factors, Nosek, Greenwald, and Banaji (2007) recommended it for making group comparisons when latencies are variable between groups.

In a typical IAT design, D is computed for data aggregated across all trials including practice trials. In contrast, the IRAP’s design allows its D_{IRAP} effects to be calculated at the most fine-grained level. In other words, the IRAP allows a D_{IRAP} score to be calculated for each trial-type (i.e., the four possible stimulus combinations of sample- with target-type; see Figure 1), on each of the three pairs of consistent and inconsistent test-blocks. In calculating the D-transformation with the IRAP’s response latency data, we used only the response latency data from test-blocks (i.e., blocks 3-8 of the SIP-IRAP), and dropped trials with latencies greater than 10,000 msec. We then calculated the mean latencies of consistent (C) and inconsistent (I) trials for each trial-type, found the collective standard deviation (SD) among the C and I trials for each trial-type; and this allowed us to calculate $D_{IRAP} = (Mean_I - Mean_C)/SD$ for each trial-type (see Vahey, Barnes-Holmes, Barnes-Holmes, & Stewart, 2009).

In each case the magnitude of the resulting trial-typed D_{IRAP} indicates the degree to which the participant is inclined, based on their particular behavioural history, to provide the particular relational responses deemed consistent for that trial-type’s sample/ target-type combination. In the specific case of the current study, the trial-type D_{IRAP} scores computed for the SIP-IRAP indicated the degree to which the participant is more
fluent at providing the relational response “Similar” for the two trial-types “Smoker-Social Acceptance Descriptors” and “Nonsmoker-Social Rejection Descriptors,” and the relational response “Opposite” for the remaining two trial-types (“Smoker-Social Rejection Descriptors” and “Nonsmoker-Social Acceptance Descriptors). In other words, the sign of the SIP-IRAP’s $D_{IRAP}$ score for each trial-type indicates whether the participant is biased towards the response relation associated with consistent trials (+; pro-smoker/anti-nonsmoker) versus inconsistent trials (-; anti-smoker/pro-nonsmoker).

A paired-samples t-test was conducted to evaluate the impact of practice on the improvement of response accuracy between the practice- and test-blocks of the preparation-IRAP. There was a statistically significant increase in the participants’ response accuracies from the preparation-IRAP’s practice-blocks ($M = 70\%$, $SD = 17\%$) to their test-blocks ($M = 78\%$, $SD = 21\%$), $t(15) = -2.218$, $p = .04$.

Furthermore, according to Fishers exact test ($p = .0096$; $phi = .83$), there is a statistically significant relationship between whether participants reached at least 70% accuracy on the test-blocks of the preparation-IRAP, and whether they then maintained at least 70% accuracy on each of the later SIP-IRAP test-blocks. Whereas 92% of participants who attained an average accuracy of greater than 70% on the preparation-IRAP’s test-blocks then went on to also maintain this level of accuracy on the SIP-IRAP’s test-blocks, 100% of those who failed to attain a mean accuracy of at least 70% on the preparation-IRAP’s test-blocks also failed to do so on the subsequent SIP-IRAP’s test-blocks.

Based on the foregoing two sets of findings, we therefore sought to explore whether there was a correlation between the participants’ response accuracies on the test-blocks of the SIP-IRAP, and the observed improvements in participants’ response accuracies from the practice-phase of the preparation-IRAP’s to its test-phase; using a Pearson’s product-moment correlation we found that there was a strong, statistically significant, positive correlation between these two variables ($r = .688$, $N = 16$, $p = .002$).

To test the hypothesis that adolescent smokers would tend to relate the word “Smoker” as similar to words commonly associated with acceptance (“cool,” “tough,” “independent,” “popular”), but that nonsmokers would not, we calculated $D_{IRAP}$ scores for each of the four trial-types (Smoker-Acceptance Items, Smoker-Rejection Items, Nonsmoker-Acceptance Items, and Nonsmoker-Rejection Items). Table 3 shows the differences between smoking and nonsmoking participants in terms of their trial-typed $D_{IRAP}$ effects. While the two groups did not differ from one another with respect to

<table>
<thead>
<tr>
<th>Word Pairs</th>
<th>Example</th>
<th>Smokers</th>
<th>Nonsmokers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smoker Acceptance</td>
<td>[Smoker-tough]</td>
<td>.21$^{1,2}$</td>
<td>.07</td>
</tr>
<tr>
<td>Nonsmoker Rejection</td>
<td>[Nonsmoker-weak]</td>
<td>.34</td>
<td>.00</td>
</tr>
<tr>
<td>Smoker Rejection</td>
<td>[Smoker-weak]</td>
<td>.07</td>
<td>.05</td>
</tr>
<tr>
<td>Nonsmoker Acceptance</td>
<td>[Nonsmoker-tough]</td>
<td>.05</td>
<td>.01</td>
</tr>
</tbody>
</table>

Notes

$D_{IRAP}$ differs significantly from zero: ($D = .21; t(4) = 3.831, p < .0187$).

$D_{IRAP}$ direction differs from chance: Wilcoxon sign test ($V = 15, p < .03$).
Smoker-Acceptance items (Mann-Whitney $U=15$, $p=.52$), smokers showed significant entailment of Smoker and Acceptance words with Similar ($D=.21$; $t(4)=3.831$, $p<0.0187$) but the nonsmokers did not ($D=.07$; $t(7)=0.0091$, $p=0.995$). The direction of the smokers’ individual $D_{IRAP}$ scores for the Smoker-Acceptance trial-type collectively deviated significantly from chance according to a one-sample one-tailed Wilcoxon sign test ($V=15$, $p<.03$; Carnal & Riedwyl, 1972; Hollander & Wolfe, 1973); only three of the eight nonsmokers showed this pattern ($V=18$, $p=.52$).

For Nonsmoker-Rejection items, although the difference between the two groups did not reach statistical significance ($U=14$, $p=.43$), smokers and nonsmokers did produce qualitatively different patterns of responding. Whereas, smoker participants appeared to entail Rejection words as Similar to Nonsmoker ($D=.34$; although the difference from zero was not significant; $t(4)=1.3164$, $p>.258$), in contrast nonsmoking participants showed no differential fluency between similar or opposite relational responses on Nonsmoker-Rejection items ($D=.00$). Neither of the two groups demonstrated differential preference for Similar versus Opposite when relating between Acceptance items and the Nonsmoker sample, nor between Rejection items and the Smoker sample.

**DISCUSSION**

Our preliminary data appear to reflect a verbal network in which adolescent smokers perceive smokers as more socially accepted than do nonsmokers. Such evaluative biases are important among adolescent smokers because they bolster peer influences that both precipitate smoking and later act as barriers to smoking cessation (Dal Cin et al., 2007). The attempts by tobacco advertisers to link social acceptance to smoking may be particularly salient when addressed to adolescents at a time when social belonging is of paramount importance. Indeed, many researchers have demonstrated how nonsmoking adolescents who consider themselves as similar to peers who smoke, have greater intentions to smoke and are more likely subsequently to initiate smoking (Tickle et al., 2006). Similarly, adolescent smokers with strong self-reported smoker identities are defensively motivated when confronted with persuasive antismoking attempts so that they exhibit greater message resistance and their perception of the social support for smoking increases (Falomir & Invernizzi, 1999). Indeed, in the present study, smokers, but not nonsmokers, tended to relate ‘Smoker’ as similar to acceptance words. This was consistent with the hypothesis that adolescent smokers see smokers as socially accepted, just as tobacco advertisements communicate. Moreover, smokers from the current study also typically related ‘Nonsmoker’ as being similar to Rejection words, although this medium-sized effect was not statistically significant.

Nonsmokers’ $D_{IRAP}$ scores were close to zero, indicating that they made consistent (pro-smoker or anti-nonsmoker) and inconsistent (antismoker or pro-nonsmoker) responses with similar fluency on all four relational stimulus classes assessed by the IRAP. Such ambivalence among adolescent nonsmokers may contribute to susceptibility to smoking uptake, and tentatively suggests that anti-smoking advertising attempting to stigmatize smoking, may be less effective than previously hoped in terms of ameliorating risky social identity preferences.
At first, it may seem counterintuitive that non-smokers did not preferentially deny the ‘Similar’ relation between ‘Nonsmoker’ and derogatory terms such as “Weak” or “Lame,” or that they did not preferentially affirm the ‘Similar’ relation between ‘Nonsmoker’ and the Social Acceptance terms used. However, if (as seems likely) non-smokers do not reliably relate content about themselves in terms of being a nonsmoker, then according to the REC model, the ambivalence of nonsmokers in the current study is expected. Such nonsmokers would require habitual and extended derived relational responding in order to establish an evaluative bias for the ‘Nonsmoker’ sample stimulus. For example, “I’m a non-smoker” would presumably need to be frequently cohered with “I’m not lame,” before these nonsmokers could habitually derive the relational response, “Nonsmokers are not lame.”

Similarly, the ambivalence displayed by smoker participants on IRAP trials with Smoker-Rejection and Nonsmoker-Acceptance stimulus combinations may at first seem counterintuitive given its lack of logical coherence with the smokers’ observed bias for relating ‘Smoker’ as similar to acceptance words; however, the REC model readily provides an explanation for this incoherence in terms of the primary role of peer influence in adolescent smoking. To the extent that adolescent smokers as a group smoke to achieve peer approval, it makes sense that they are unlikely to habitually frame their thoughts about smokers in pejorative terms or their thoughts about nonsmokers in terms of descriptors pertaining to social acceptance. Indeed for adolescent smokers, smoker-derogating or nonsmoker-promoting characterizations are likely uncommon and devalued because of their incompatibility with ongoing smoking for peer acceptance. In which case, it stands to reason that adolescent smokers will show no IRAP effect with regard to either smoker-derogating or nonsmoker-promoting characterizations, if such characterisations are typically absent among adolescent smokers’ cognitions. After all, IRAP effects are designed to measure the differential fluency of consistent versus inconsistent relational responding as a reflection of their relative frequencies in the participant’s behavioural history; and so, when both consistent and inconsistent response classes are infrequent in that behavioural history, it implies that these opposing response classes will not differ in terms of their response fluency, and therefore not produce an IRAP effect. In other words, the REC model predicts that even if a smoker is accustomed to thinking favorably about Smokers so that they are biased toward answering “True” rather than “False” when asked whether “Smokers are Cool”, they would nevertheless show no bias between “True” and “False” responses to the statement “Smokers are Lame”, if they were unaccustomed to thinking in pejorative terms about smokers (i.e. in terms of denying pejorative descriptors). This interpretation coheres with the broader observed constellation of IRAP effects for the adolescent smokers in the current study: they showed evaluative biases in terms of promoting smokers and derogating nonsmokers (i.e. both propositions are directly relevant to adolescent smokers’ social identity), but showed no corresponding biases in terms of derogating smokers or promoting nonsmokers (i.e. propositions that are likely infrequent within their behavioural histories).

Importantly, these findings demonstrate that the IRAP is sensitive to whether a person is biased toward cognizing more about a particular sample stimulus in derogating versus complimentary terms (e.g., “tough” vs. “weak”). Much like the subjective
difference between considering a glass half-full versus half-empty, it seems that smokers’ conceptions of the social identities of “Smoker” or “Nonsmoker” differ in important ways depending on the evaluative dimensions used by smokers in framing these conceptualizations. This interpretation of the logical incoherence observed among the adolescent smokers’ implicit biases comports with similar phenomena in matching-to-sample (MTS) research (Reilly, Whelan, & Barnes-Holmes, 2005), in the syllogistic reasoning literature (Goodwin & Johnson-Laird, 2005, p. 471), and from IRAP data in other domains (Barnes-Holmes, Murphy et al., 2010; Cullen et al., 2009, p. 605; Hughes & Barnes-Holmes, in press; Power et al., 2009b; Vahey et al., 2008; Vahey et al., 2009), indicating the generality of this experiential phenomenon: an individual can have qualitatively differing evaluative biases with regard to a particular concept, depending on the evaluative dimension used to relate to the concept (and such incoherence will remain in the absence of deliberation to resolve the disjointed relational response networks in question; see Barnes-Holmes et al., 2010). Our observations therefore illustrate the utility of the IRAP, particularly given that the foremost implicit measure, the IAT, cannot detect this subtle experiential phenomenon.

The primary objective of the current preliminary study was to outline the conceptual rationale for, and the potential utility of the IRAP as a tool suitable for examining adolescents’ attitudes to stigmatized behaviours. We demonstrated how even with relatively small numbers of participants, the IRAP is somewhat sensitive to readily interpretable known-groups differences between adolescent smokers and nonsmokers. However, the foregoing conclusions should be interpreted with a measure of caution given the exploratory nature of the current study: because of its low number of participants, and their potential for heterogeneous social identity preferences as a function of their wide age-range (i.e. 13-19 years of age). Nevertheless, we anticipate that future IRAP investigations show some potential as a means of capturing adolescents’ implicit attitudes. Indeed, the IRAP may provide more precise and comprehensive analyses of adolescents’ attitudes, to the extent that they incorporate a greater number of participants within each known group.

The precision of any particular IRAP is fundamentally intertwined with the degree of experimental control it is capable of applying to a given analytic question. According to the REC model, greater experimental control over participants’ relational responding is realizable to the extent that participants maintain high accuracies while responding quickly to IRAP tasks that are well-defined in terms of the phenomena of interest (Barnes-Holmes et al., 2010). The process of formulating the current preliminary study highlighted the necessity during initial IRAP design and pilot phases, of iteratively selecting IRAP stimuli so as to achieve relatively homogeneous and characteristic differences between the IRAP effects of the known-groups being compared. In other words, IRAP stimuli should be refined using pilot samples so that they reflect relational responding that typically differs meaningfully between the two or more so-called known-groups being compared. To create a successful interplay between known-groups sampling and IRAP stimulus design, the research must tether the sampling of known-groups to tangible sampling criteria that are refined more and more in terms of the IRAP stimuli across the pilot phases. By the same token, the selection of IRAP
stimuli should also be fine-tuned in terms of what is known about the currently favoured samplings, so as to capture homogeneity within those known-groups via the IRAP. For example, an analysis of smokers versus nonsmokers might develop into an analysis of smokers versus never-smokers, as we come to realize, that the inclusion of ex-smokers obscures the meaning of our chosen IRAP stimuli (thereby providing less contrast between the known-groups).

Our analysis of participants’ response accuracies across the preparation-IRAP and SIP-IRAP also yielded important information pertaining to the optimisation of the IRAP. We found statistically significant improvements in participant response accuracies on the preparation-IRAP from its practice- to its test-blocks, which in turn was strongly and positively correlated with the response accuracies recorded on the subsequent SIP-IRAP test-blocks. These findings provide initial tentative evidence for the assertion that participants who familiarise themselves with the IRAP methodology by engaging with a so-called preparation-IRAP, may then achieve higher response accuracies on presentations of the conventional IRAP that follow soon thereafter. This finding is notable in particular, because it constitutes the first empirical evidence for a technique capable of improving the accuracy of participant responding during IRAP test-trials. However, while the preparation and practice phases we provided seemed to familiarize participants with some demands of the experimental procedure and the display environment, nevertheless some 19% of the participants’ SIP-IRAP responses were not sufficiently accurate for their SIP-IRAP data to be interpretable.

To add further incremental steps towards addressing the issue of IRAP optimisation, we propose to incorporate adjunctive protocols that delay procession to IRAP test-blocks until participants have attained latency and accuracy criteria by repeatedly pre-practicing with relevant IRAP tasks. In principle, there are many ways of practicing to latency and accuracy criteria (e.g. fixed predefined latency criteria versus idiographic floating latency criteria adjusted in vivo to account for ongoing improvements in an individual’s IRAP performances). Indeed, the rapidly evolving IRAP literature has already gone much of the way towards piloting similar adjunctive optimisations of the IRAP. For example, in a study conducted simultaneously with the current research, Vahey et al. (2009) facilitated the successful implementation of a self-esteem IRAP with a sample of prisoners who had earlier found the IRAP tasks relatively insoluble: the prisoners were cycled through repeated pairs of consistent and inconsistent trial blocks on a self-esteem IRAP until they attained at least 80% accuracy on both trial blocks in a practice cycle; afterwards they maintained a 70% accuracy during the test-phases. Some later studies partially incorporated this approach to impose post-hoc latency and accuracy requirements as criteria for inclusion in their analysis of IRAP test-block data (Chan et al., 2009; O’Toole & Barnes-Holmes, 2009). However, in order to maximise the number of participants achieving these post-hoc criteria, later IRAP studies incorporated a priori response criteria; participants’ IRAP responses were required to be at least as fast and accurate as predefined criteria before they were allowed to proceed to the IRAP’s test-phase (Barnes-Holmes, Murphy et al., 2010; Barnes-Holmes, Waldron et al., 2010; Dawson et al., 2009; Hughes & Barnes-Holmes, in press; Roddy et al., 2009). Indeed, the findings of Barnes-Holmes, Murphy et al. (2010) specifically address
the benefits to experimental control of postponing the IRAP test phase until participants meet pre-defined speed and accuracy criteria on practice IRAP tasks. They found that by reducing the practice- and test-phase response latency criteria by 1000 msec, while holding the response accuracy criterion at 80%, significantly increased the extent of in-group stereotyping measured on an IRAP measuring implicit racial attitudes.

The current study was useful, in that it tentatively demonstrated how even with relatively small numbers of participants, the IRAP is somewhat sensitive to readily interpretable known-groups differences between adolescent smokers and nonsmokers. Indeed, it is worth noting that the implicit relational effects detected by the IRAP in the current study are not discriminable by any other existing implicit measures. The current study also successfully provided the first tentative empirical evidence, recommending the use of adjunctive procedures for optimising the accuracy of participant responding on the IRAP. It thereby provides an illustrative starting point for the emergence of an empirically-based rationale supporting the use of adjunctive IRAP procedures, that formally impose response latency and accuracy criteria upon participants while they engage with the IRAP. Although it is not possible (nor perhaps desirable) to completely eliminate some degree of current contextual control from influencing IRAP measurements, it seems worthwhile to continue the development of adjunctive optimisation procedures that minimize extraneous contamination of the IRAP.

With these ongoing developments, we believe that the IRAP will prove to be a versatile tool for testing hypotheses about the verbal networks of adolescents. For example, in future we propose testing the feasibility of adaptive automated training procedures to further enhance participant preparation as a means of facilitating the precision of the IRAP. With such optimisations, an important next step will be to use the IRAP prospectively to examine the developmental role of verbal biases, in the complex emergence of relatively stigmatised or impulsive behaviours that are not readily amenable to self-report measures. Indeed, in light of our findings, such optimised IRAPs appear to hold some promise, as a means to explain how smoking identity preferences contribute to the emergence of smoking behaviours during adolescence.

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