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DOI
10.1007/s40429-019-00254-2

Publication date
2019

Document Version
Final published version

Published in
Current Addiction Reports

Current Addiction Reports (2019) 6:200–209
https://doi.org/10.1007/s40429-019-00254-2

FOOD ADDICTION (A MEULE, SECTION EDITOR)

Assessment of Automatically Activated Approach–Avoidance Biases Across Appetitive Substances

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Published online: 14 May 2019

Abstract

Purpose of Review Automatic approach–avoidance tendencies drive excessive intake of drugs and unhealthy food. Dual-process models of behaviour propose that strong approach biases predict excessive intake when reflective processes are weak. Consistent with theory, early findings indicated that approach biases predicted excessive use of drugs, including alcohol and tobacco. Given that reviews on approach bias for appetitive substances are lacking, the current review aimed to synthesise the recent findings on automatic approach biases across three of the most commonly assessed substances: alcohol, food and tobacco.

Recent Findings The findings suggest that approach biases exist for a range of substances, are mostly stronger in clinical samples than healthy controls and predict consumption behaviour, albeit under certain conditions.

Summary Approach biases for appetitive substances are related to excessive consumption in line with theoretical premises. Further longitudinal research is needed, particularly in the domains of tobacco and food, to determine the prediction of consumption of these substances over time. Nevertheless, the findings highlight a continued need for approach bias modification techniques aimed at changing this underlying mechanism.

Keywords Approach–avoidance bias · Action tendency · Implicit cognition · Alcohol · Tobacco · Food

Introduction

Excessive consumption behaviours in the domains of smoking and drinking as well as overeating are thought to be influenced by automatically activated approach biases for appetitive substances, such as tobacco, alcohol and unhealthy foods [1, 2]. Approach bias refers to the automatically activated action tendency to reach out toward appetitive cues [3]. Indeed, early research demonstrated the existence of approach bias for substance-specific cues in obesity [4] as well as in heavy drinkers [5], and smokers [6]. These theoretical premises and empirical findings have resulted in the use of approach bias modification techniques, which are aimed at modifying automatic approach biases in order to influence the related consumption behaviour. A key outcome in approach bias modification studies is a change in the underlying mechanism, namely, approach bias. In this review, we aimed to synthesise the recent research on approach biases for a range of appetitive substances.

The Theoretical Role of Approach Bias

Neurocognitive theories such as dual-process models have been prominent in explaining the role of automatically activated cognitive processes, including approach bias, in maladaptive consumption behaviours [2]. For example, the key theoretical premise of reflective-impulsive models is that our behaviour is regulated by two separate, but interactive information processing systems [7]. The impulsive (or automatic) system is fast and regulates behaviour based on previously formed associations (e.g. approach appetitive, high-calorie foods). In contrast, the slower reflective system relies on explicit knowledge (e.g. the health consequences of food). Automatic approach tendencies arise when an appetitive stimulus activates the impulsive system, which is not able to be

This article is part of the Topical Collection on *Food Addiction*

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overridden by cognitive control processes due to a weakened reflective system. Dual-process models have prompted the idea of targeting automatic processes to change problematic consumption behaviour [3].

Although dual-process models provide a theoretical framework for this review, it is important to note that these models have been subject to recent criticism and are currently being revised in the area of addiction [8]. Dual-process models have been criticised because of neural implausibility and theoretical problems [9, 10]. Rather than two separate systems, the revised perspective emphasises iterative processing, in which early information processing becomes biased by conditioned reward stimuli [11], or addiction-related cues, which increases the chance that the corresponding behavioural option is pursued [2, 12, 13]. Important in both original dual-process models and in recent reformulations is the concept of motivation [13, 14]. Specifically, automatically activated tendencies in health behaviours are only moderated when there is sufficient ability (i.e. executive control), and motivation to control unhealthy behavioural tendencies, which suggests that there are three interactive processes at play [15].

Approach Bias Assessment Paradigms

Approach biases can be assessed using computerised tasks that measure reaction times (RTs) to a visual stimulus. The three main paradigms that have been used to measure such biases are the Approach–Avoidance Task (AAT), the Stimulus-Response Compatibility (SRC) task and the approach–avoidance variant of the Implicit Association Test (IAT). One important difference between these three commonly used paradigms is whether the task measures symbolic approach–avoidance responses (as with the SRC task), actual approach–avoidance motor movements (as with the AAT) or approach–avoidance associations (as with the IAT; [16]).

In the AAT, participants respond to images that appear on the centre of a screen by moving a joystick toward or away from themselves using actual motor movements [17]. Pulling the joystick toward themselves (closer to their body) simulates approaching the image, whilst pushing the joystick away from themselves (further from their body) simulates avoiding the image. The AAT has a perceptual zooming feature such that pushing the joystick (avoidance) increases the image size, whereas pulling the joystick (approach) decreases it. In the SRC task, participants respond to presented images by pressing keys on a keyboard to perform symbolic approach–avoidance movements [18]. Images are also presented in the centre of a screen with a manikin figure positioned above or below. Participants press the up or down keys to move the manikin toward (approach) or away from (avoid) the image. For both the AAT and SRC task, relative RTs on approach versus avoidance trials indicate the strength of automatically activated action tendencies. That is, faster RTs for approaching versus avoiding indicate an approach bias, whilst the opposite indicates an avoidance bias.

Furthermore, for both tasks, relevant feature and irrelevant feature versions have been created. In a relevant feature version, participants respond to the image based on the content (e.g. 'avoid' alcohol images and 'approach' soft drinks images). In an irrelevant feature version, participants respond to a feature unrelated to the contents of the picture, such as format (e.g. approach portrait; avoid landscape) or orientation (e.g. pull when picture has a slight left tilt and push when it has a slight right tilt). The irrelevant feature version of the AAT has been widely used for intervention studies as the assessment task can easily be modified to a modification task by changing the task contingencies without changing the instructions. Specifically, in the assessment phase, images are presented in push format on 50% of trials and in pull format on the other 50% of trials. In the training phase, the target images (e.g. alcohol) can be presented in push format on 90% of trials (or 100% or 80%) and in pull format on 10% of trials (or 0% or 20%), and vice versa for control images (e.g. soft drinks).

The approach–avoidance variant of the IAT measures the strength of association between concepts [19–21]. The task is to categorise stimuli presented consecutively on a screen according to a target (e.g. soft drinks vs. alcohol) or an attribute dimension (e.g. approach vs. avoid). In the first block, one target and one attribute dimension (e.g. alcohol and approach stimuli) are paired together on one side of the screen (with soft drinks and avoid on the other side), such that they share a response key (e.g. left). In the second block, the pairing is reversed for the target dimension (e.g. alcohol and avoid stimuli vs. soft drinks and approach stimuli). The difference in mean RTs is calculated between these two combined blocks. Participants are expected to be faster to respond when two associated target/attribute dimensions share a response key (e.g. alcohol and approach stimuli) than when two non-associated target/attribute dimensions share a response key (e.g. alcohol and avoid).

Scope of the Review

In the last decade, a vast body of literature has emerged on approach bias for appetitive substances. Most reviews have focused on intervention studies using approach bias modification (e.g. [22–24]), rather than assessment of such biases. Although a recent review evaluated the assessment of approach biases only for drug-related cues [25•], it remains unclear as to how such biases function across appetitive substances. Thus, in the current review, our goal is to provide an integrated summary of recent research on approach biases for several substances, namely, alcohol, cigarettes and food. The aim is threefold: (1) to compare the strength of approach bias for substances across groups with differing levels of consumption and in clinical groups versus healthy controls, (2) to

determine whether the strength of the approach bias predicts overt or self-reported consumption behaviour and (3) to characterise experimentally manipulated moderators of approach bias for substances and its relationship with consumption. Finally, we provide recommendations for future research on approach bias assessment and discuss theoretical and practical implications for intervention studies. We have focused on research published in the last 5 years to ensure timeliness.

Review of Recent Findings

The included articles were organised into three categories: (1) studies comparing groups with differing levels of consumption, (2) predictive validity studies and (3) experimental validity studies, based on previous reviews on implicit cognitive processing (e.g. [26]). The first category includes studies that used a quasi-experimental design to compare groups with differing levels of substance-related issues (e.g. heavy vs. social drinkers) or to compare a group with a clinical disorder (e.g. binge eating disorder) with a healthy control group. The general hypothesis is that the groups with a higher level of substance use or a disorder will show a stronger approach bias for disorder-relevant stimuli (e.g. alcohol or high-calorie food cues). The second category of studies examined whether approach bias predicts consumption, including both self-reported and overt behaviour. The third category of studies manipulated an aspect of the task or the participants and examined the effect on approach bias or its relationship with behaviour.

Studies Comparing Groups with Differing Levels of Substance-Related Issues

Alcohol In the last 5 years, only a few studies have examined approach bias for alcohol cues in groups with differing levels of alcohol use. For example, among undergraduate students, there is emerging evidence of heightened approach bias toward alcohol cues (e.g. scenes of drinking alcohol with friends) in heavy social drinkers compared with light social drinkers using a novel virtual reality paradigm [27], and in individuals with low, but not high sensitivity to the acute effects of alcohol (AAT; [28]). In contrast, evidence from research on clinical populations found that approach biases for alcohol cues were neither observed in current or abstinent problematic drinkers nor in light drinkers in individuals with an IQ ranging from 50 to 85 [29, 30]. The authors concluded that approach–avoidance paradigms may lack sensitivity in certain populations, but their conclusions were drawn based upon assessment with the AAT. It remains to be determined whether other measures (e.g. the IAT or the SRC task) are suitable for assessing automatically activated approach–avoidance tendencies in such populations [31].

Tobacco Several recent studies have emerged on approach bias for tobacco-related cues. Specifically, approach bias for cigarettes using the AAT did not differ between smokers and non-smokers among adolescents [32, 33•] or adults [34]. Similarly, in smokers, cravers, ex-smokers and non-smokers, there was no difference in approach bias on the AAT or the SRC, but on the IAT, cravers showed a stronger approach-association and non-smokers showed a stronger avoidance-association, both of which were not observed in the smokers or ex-smokers [16]. Interestingly, these findings contrast with earlier research showing that heavy smokers had a stronger approach bias for smoking cues than non-smokers and ex-smokers [6]. Recent studies have also examined approach biases for other appetitive cues in smokers. Among risky drinkers, smokers showed a stronger alcohol-approach association than non-smokers (IAT; [35]), whilst smokers, unlike non-smokers, did not show an approach bias for food (AAT; [34]). Thus, smoking may increase the risk of engaging in other addictive behaviours [36], but reduce sensitivity to natural rewards such as food [37].

Food Research has also compared approach bias for food in groups with differing levels of eating-related issues. Several of these studies found that individuals with overweight or obesity, but not healthy-weight controls, showed an automatic approach bias toward food cues using the approach–avoidance version of the IAT [38] and the AAT [39, 40]. In contrast, a recent study found that children with overweight or obesity did not show a stronger approach bias for unhealthy food cues than healthy-weight children [41]. However, the children with excess weight may have received reminders to avoid unhealthy foods as they were mostly recruited from weight loss facilities (for an experimental demonstration of such a context effect in adults cf. [42]). Similarly, the only study to examine approach bias in binge eating disorder (BED) and obesity found that both obese individuals with BED and healthy-weight controls displayed an avoidance bias for low-calorie food cues, whilst those with obesity alone displayed an approach bias for such cues [43]. However, it may be that affect influences approach bias for food in BED as binge episodes often occur during negative mood states.

In non-clinical samples, research using the AAT has also shown that approach bias for high-calorie food (relative to non-food cues) was stronger in individuals with higher food craving [44], and reward sensitivity [45]. Similarly, individuals bothered by their snack eating habit were slower to avoid both high-calorie and low-calorie food than healthy controls, but there was no group difference in approach responses toward such cues [46]. Thus, evidence points toward faster approach responses for high-calorie versus low-calorie or non-food cues, in line with earlier research showing that highly rewarding cues elicit stronger approach tendencies [47]. The mostly consistent findings in the food

domain are noteworthy given the use of different assessment tasks and samples.

Predictive Validity Studies

Alcohol Early research demonstrated a positive relationship between approach bias for alcohol and alcohol use (e.g. [4]), supporting the idea that approach bias predicts consumption. However, these promising findings can be contrasted with an emerging body of research revealing largely mixed findings. For example, some studies found that in current drinkers, a stronger approach bias (on the AAT) was positively associated with hazardous [48] and future drinking [49••], whilst other studies found no relationship between approach bias and current or future drinking [50••, 51, 52].

The mixed findings may largely be explained by differences in sample characteristics (e.g. abstinent vs. currently drinking, treatment seeking vs. non-treatment seeking, age and gender), the assessment task and how approach bias was calculated and/or analysed (for more detail, see [53]). Indeed, in some studies, an approach bias toward alcohol cues was not observed at all (e.g. [50••]), and in other studies, an avoidance bias was observed instead (particularly in abstinent patients who had undergone detoxification treatment; SRC task, [54]; IAT, [55•]). One reason for these inconsistent findings is that the majority of approach bias assessment tasks use an index of approach that is relative to avoidance tendencies. However, approach and avoidance tendencies likely reflect two independent processes and, hence, a score that combines the two may fail to reveal the actual contribution of each tendency [53].

Aiming to address this limitation of the standard SRC task, a few recent studies have used a modified SRC task, which allows for the assessment of approach and avoidance tendencies separately [53]. In a sample of current heavy drinkers, Baker et al. [53] did not find an approach bias for alcohol cues compared to control (neutral) cues. Likewise, in a sample of abstinent outpatients who had undergone detoxification treatment, Field et al. [50••] did not find evidence of an approach bias for alcohol use at baseline (following detoxification) using the modified SRC task, nor did they find that it predicted current dependence or consumption, or relapse at any future time point (in contrast to stronger avoidance, which was found to predict relapse at follow-up and supports the findings of earlier research, e.g. [56]).

The approach–avoidance variant of the IAT has also produced mixed results, with some studies finding a stronger approach bias on this task was positively associated with alcohol use [55•], and other studies finding no such relationship [52], or even the opposite relationship, namely, prediction of less drinking in the future, albeit only in adolescents with low *positive* alcohol expectancies [57]. Interestingly, in adolescents, greater approach bias on the SRC task has been shown to predict current drinking ([58], but see [51]) and future drinking (but, only in those with low *negative* alcohol expectancies [57]).

Tobacco In contrast to alcohol, there has been a paucity of recent research on the relationship between approach bias for tobacco and smoking behaviour. One study observed that approach bias for cigarette-related cues did not predict self-reported nicotine dependence nor daily cigarette use [32]. However, these findings are yet to be confirmed in samples of heavy adolescent smokers or adult smokers.

Food There are relatively fewer studies examining the link between approach bias for food and consumption, but the findings have been more consistent. Specifically, approach bias for unhealthy food predicted uncontrolled eating in adolescents with higher impulsivity [59] and increased food consumption in adults with poor inhibitory control [60], as well as overweight external or emotional eaters [39]. The finding that cognitive control moderates the effect of approach bias on consumption is in line with dual-process models. Recent studies examining the relationship between approach bias and a proxy of adiposity, namely, body mass index (BMI, kg/m^2), found that increased BMI was related towards reduced avoidance of sweet food (on the AAT, but not the IAT; [61•]), and faster approach of food using a virtual reality paradigm [62]. However, it should be noted that BMI may not be an indicator of excessive eating given that it is related to many different factors (e.g. exercise). Given that most of these studies used healthy convenience samples, the nature of the relationship between approach bias for food and eating behaviour remains unclear in clinical samples. Nevertheless, these findings indicate the potential relevance of approach–avoidance tendencies for food in eating behaviour.

Experimental Validity Studies

Experimental studies can provide valuable insights into potential moderators in line with dual-process models, which predict that the relationship between automatic and reflective processes is influenced by a number of variables, including temporal dynamics [12] and control resources (e.g. affect, cognitive load, hunger; [63]) or substance use [15].

Alcohol Only one recent study has examined the potential role of temporal dynamics in approach bias. Specifically, Gladwin et al. [63] found that in a sample of social drinkers, approach bias for alcohol cues variably decreased as a function of manipulated delay between stimulus presentation and response, albeit for both the alcohol and soft drink images. Nevertheless, their finding that such biases are time-dependent processes that decay over longer delays has clinical implications. Specifically, training participants to delay their responses to substance-related cues may assist in reducing approach

tendencies, which could contribute to improving the efficacy of approach bias modification interventions [20].

Another variable that has been shown to influence the relationship between approach bias and alcohol use is whether the assessment task instructions are explicitly related to alcohol (relevant feature versions), or whether approach–avoidance responses are elicited implicitly (irrelevant feature versions). Kersbergen et al. [48] compared the ability of four measures of approach bias to predict alcohol use in a sample of college students (who drank at least once a month), and found that the two relevant feature versions of the SRT and AAT predicted hazardous drinking, whilst the two irrelevant versions of the same tasks did not. Thus, the relevant versions may be more reliable and valid and, hence, better suited to the assessment of approach bias [48]. Nevertheless, the irrelevant feature versions, in particular of the AAT, can be more easily adapted for use as an approach bias modification paradigm [2].

Alcohol research has also examined whether affective stimuli influence approach bias and consumption. Specifically, video clips depicting positive or negative aspects of drinking behaviour successfully increased approach and avoidance of alcohol cues, respectively [64], further supporting the idea that approach and avoidance biases are independent processes [53]. Similarly, using a sample of occasional and heavy drinkers, Cousijn et al. [65] paired alcohol images with positive, negative or appetitive (non-alcoholic) images on the AAT. They found that a negative context increased approach bias for alcohol relative to the appetitive context, an effect driven by slower avoidance rather than faster approach. Alcohol-promoting advertisements were also shown to increase approach bias relative to non-alcohol advertisements, but there was no effect on consumption [66••]. In contrast, priming of sexual identity ambiguity through a writing exercise was associated with a discernible increase in alcohol-approach bias and consumption in a laboratory taste test [67].

Cognitive load has also been experimentally manipulated in alcohol research with mixed findings. Specifically, some research has found a relationship between alcohol-approach bias and consumption under low, but not high cognitive load among social drinkers (AAT; [68]) whilst others found no such moderating effect in heavy drinkers (IAT; [52]). A potential reason for the discrepant findings is that these studies differed in the assessment tasks used (AAT vs. IAT). Specifically, the AAT may provide a more accurate assessment of approach bias given that it can be used to directly assess approach–avoidance motor movements rather than symbolic movements (SRC) or associations (IAT). Another reason may be the type and timing of the cognitive load manipulation. Specifically, the interference suppression manipulation was embedded within the AAT task [68], whilst the ego depletion paradigm ('cross out e' task) was administered prior to the AAT assessment [52]. However, both studies used a laboratory taste test paradigm to measure alcohol consumption, which has been subject to long-standing concerns regarding ecological validity ([69], but see [70]).

Research has also examined the moderating role of substance use in the relationship between approach bias and consumption behaviour. Cohn et al. [71] found that approach bias toward alcohol, but not cigarette cues, predicted proportion of heavy drinking days during nicotine deprivation. Their findings suggest that cigarette withdrawal may increase motivation to drink, but not smoke. It remains to be seen whether these findings can be applied to the consumption of other substances, such as food, given recent evidence that nicotine withdrawal increases food consumption, which was not explained by metabolic factors [72]. More recently, Jünger et al. (2017) [73] demonstrated that alcohol intoxication did not affect approach bias for alcohol (on the AAT) in healthy young males, however, it is important to note that approach bias was low at baseline, which was possibly due to the nature of the sample.

Food The idea that affective stimuli modulates approach bias has also been applied to eating research. Recent evidence showed that health beliefs could be induced by labelling images of identical beverages as 'high-calorie' or 'low-calorie', such that participants showed a stronger approach bias for the preferred beverage (the one labelled as low-calorie), as indicated by a subsequent choice task [74]. Exposure to socially framed norms ('approval of fruit consumption' and 'disapproval of candy consumption' messages) heightened approach bias for healthy relative to unhealthy food [75], whilst attentional priming increased approach bias for unhealthy food [76]. However, it is unknown whether health beliefs, social norms or attentional priming influence the relationship between approach bias and food consumption.

Another variable predicted to reduce cognitive control resources is hunger. Research has been mixed, with one study showing no difference in approach bias for appealing foods between hungry and non-hungry participants [77], and another finding that hungry participants had a stronger approach bias than sated participants [78]. Approach bias also moderated the link between hunger and sweets consumption, such that the relationship was weaker when approach bias for healthy food was higher [79]. Thus, homeostatic state (i.e. hunger vs. satiety) may influence approach bias for food-related cues. Furthermore, approach bias for unhealthy food cues was observed with the irrelevant feature version of the AAT, but not the irrelevant version [80••], which mirrors findings from the alcohol domain [48].

Summary

We reviewed recent empirical evidence for approach bias across a range of substances, including alcohol, cigarettes

and food. There is considerable evidence from the reviewed studies that approach biases for disorder-specific stimuli are heightened in heavy drinking [27, 28] and obesity [38–40], although some studies found no such evidence [29, 34, 41, 58] or even observed an avoidance bias [54]. Overall, the reviewed studies in the eating domain support the general hypothesis that groups with a disorder will show a stronger approach bias for disorder-relevant cues than healthy controls, whilst the evidence was somewhat mixed for alcohol. Whilst our review of the literature illustrated the presence of approach biases for all three appetitive substances, it should be noted that the evidence was inconclusive in the smoking domain. Nevertheless, identifying the existence of approach biases in individuals with obesity and social or heavy drinkers supports the continued need for interventions, such as approach bias modification, to modify these automatic processes.

Automatic approach biases were also shown to play an important role in the consumption of alcohol [48, 49••] and unhealthy food, particularly in individuals with poor inhibitory control or high impulsivity [59, 60]. However, other studies found no relationship between approach bias and behaviour (e.g. [32, 54, 55•]), but importantly these were the studies that did not observe an approach bias for the disorder-related substance. Finally, the experimental studies highlighted a number of moderators that strengthened approach bias and its relationship with consumption behaviour, such as relevant task instructions [48, 80••], negative or positive affect [64, 65, 66••], low cognitive load [68], hunger [78] and withdrawal from other substances [71]. Together, these findings support the main premises of dual-process models of behaviour, namely, that automatically activated tendencies predict behaviour when the reflective system is relatively weak (e.g. due to poor inhibitory control or high trait impulsivity), or when control resources are depleted (e.g. due to hunger, cognitive load or negative affect; [6]).

Implications for Future Research

The discrepant findings can be attributed to a number of differences across studies, such as the type of assessment task. Despite differences in operationalisation, approach–avoidance biases were still observed in studies using each of the tasks. Furthermore, both relevant and irrelevant feature versions of the tasks detected approach biases, although only two studies to date have compared different tasks (SRC and AAT) and versions of these tasks within the same sample [48, 81]. Whilst concerns have been raised regarding the reliability of irrelevant feature versions, it is important to consider that in such tasks (typically, the AAT), participants respond to a feature of the stimulus that is not related to the content that the task aims to assess, which has the advantage of masking the research question and reducing the use of response strategies [17]. Nevertheless, concerns regarding the reliability of approach–avoidance assessment tasks have led to the development of the Visual Approach/Avoidance by the Self Task (VAAST), which simulates the visual effects of whole-body rather than arm movements [82]. Future studies should aim to establish the validity of the VAAST in assessing approach–avoidance biases for appetitive substances. In addition, technological advances have begun to shift how approach bias assessment tasks are delivered. Of note, two of the reviewed studies used virtual reality paradigms [27, 62]. Using virtual environments to measure approach bias may more accurately capture automatically activated approach–avoidance tendencies given that participants have the opportunity to engage with realistic stimuli related to both the substance (e.g. alcohol) and the environment (e.g. drinking situation). Future studies should consider using more ecologically valid and engaging paradigms not only for assessing, but also for modifying approach biases.

Another important difference is the type of sample used. Most reviewed studies in the eating domain examined approach bias for food and consumption in healthy, unselected samples. Looking forward, research should aim to establish whether the substance-specific approach bias predicts consumption behaviour in clinically relevant samples, particularly in the eating domain. Furthermore, future research should examine the role of automatic approach biases for alcohol and tobacco cues across the spectrum of mild to severe substance use disorder given evidence that the relationship between automatic processing of substance-related stimuli and use is not linear [83]. It is also important to consider that most studies examining the relationship between approach bias and behaviour have relied on laboratory taste tests or self-report, both of which have their limitations, such as reliance on retrospective memory and lack of ecological validity [69, 70]. Future studies should examine the behavioural outcomes of approach action tendencies through the inclusion of more naturalistic consumption measures ‘in vivo’, such as ecological momentary assessment techniques. Finally, given the cross-sectional nature of most of the reviewed studies, more longitudinal research is needed to uncover the long-term effects of approach biases for appetitive cues on consumption.

Another challenge for the understanding of automatically activated approach–avoidance tendencies is co-morbidity. Indeed, research examined in this review highlighted that tobacco and alcohol use were interrelated [35, 71]. Thus, another direction for future research is the concurrent assessment of approach–avoidance biases and related behaviours for multiple substances. Such research will further our understanding of the shared mechanisms underlying these disorders in line with a transdiagnostic approach, which advocates for the assessment of interdependent processes and behaviours [84]. Indeed, transdiagnostic research on approach bias will have implications for modification paradigms aiming to target multiple excessive

consumption behaviours. We expect that future reviews will also include studies on approach–avoidance biases for appetitive cues in behavioural addictions, such as gambling disorder [85], or so-called addiction to social media sites [86] given the emerging research in this field.

Finally, despite the wealth of studies on the assessment of approach bias for appetitive substances, the underlying mechanisms remain unclear. Recent iterations of dual-process models posit that automatically activated action tendencies are learned by early information processing that becomes biased through associative conditioning of rewarding stimuli [11]. Indeed, recent research using eye tracking to assess value-modulated attentional capture has demonstrated that the influence of reward on attentional capture by non-drug (i.e. monetary) reward was positively related to illicit substance use among individuals with lower levels of cognitive control [87]. Theoretically, these latter findings suggest that attentional capture by reward-related stimuli may underpin automatically activated biases and excessive consumption behaviour, although the causal direction is yet to be established [11]. Future research should examine whether attentional capture by reward-related cues is associated with other automatically activated processes (e.g. approach bias) and other types of excessive consumption behaviour (e.g. unhealthy food intake).

Conclusions

Automatic approach–avoidance action tendencies for food, alcohol and cigarettes were observed, although a range of assessment paradigms were used to measure such biases. The existence of approach biases and their relationship with problematic consumption behaviours, including unhealthy eating, heavy drinking and smoking highlights the importance of approach bias modification interventions. Future research should prioritise longitudinal designs to determine whether approach bias predicts the development of problematic behaviours. There is also a need for more research using novel assessment paradigms and ecologically valid measures of consumption behaviour. Finally, future reviews on approach biases should aim to synthesise the emerging research in the field of behavioural addictions, including gambling disorder. Given that a change in the underlying mechanism is a key outcome in intervention studies, advances in approach bias assessment will also help to improve the efficacy of approach bias modification.

Acknowledgements The authors would like to thank Antonio Verdejo-Garcia for his helpful feedback on an earlier version of this paper.

Funding RSCL was supported by funding from the National Health and Medical Research Council (No. 1162031).

Compliance with Ethical Standards

Conflict of Interest Dr. Albertella has nothing to disclose.
Dr. Wiers has nothing to disclose.
Dr. Kakoschke has nothing to disclose.
Dr. Lee reports funding from the National Health & Medical Research Council (No. 1162031) during the conduct of the study. The funders had no input to the study design, data collection, or interpretation, writing of the report, or submission for publication.

Human and Animal Rights and Informed Consent This article does not contain any studies with human or animal subjects performed by any of the authors.

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• Of importance
•• Of major importance

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