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Corresponding Author	Family Name	**Vannucci**
	Particle	
	Given Name	**Manila**
	Suffix	
	Division	Department of NEUROFARBA-Section of Psychology
	Organization/University	University of Florence
	Address	Florence, Italy
	Email	manila.vannucci@unifi.it
Author	Family Name	**Pelagatti**
	Particle	
	Given Name	**Claudia**
	Suffix	
	Division	Department of NEUROFARBA-Section of Psychology
	Organization/University	University of Florence
	Address	Florence, Italy
Author	Family Name	**Marchetti**
	Particle	
	Given Name	**Igor**
	Suffix	
	Division	Department of Life Sciences, Psychology Unit
	Organization/University	University of Trieste
	Address	Trieste, Italy

Abstract	The chapter presents a review of the existing literature on mind-wandering in adolescents, addressing some relevant and controversial issues, related to the association between mind-wandering, cognitive control, and negative mood. The existing studies show that mind-wandering in adolescents is not a mere failure of attentional control and that it is not detrimental per se. The authors stress (i) the necessity of a clear operational definition of MW, which distinguishes MW from other kinds of lapse of attention, and (ii) the usefulness of a multidimensional approach to MW, based on the recognition of the heterogeneity of MW, in terms of both mechanisms and contents. Finally, some lines of research and future developments are encouraged, especially with regard to educational and psychological interventions.
Keywords (separated by " - ")	Adolescence - Identity - Cognitive control - Psychopathology - Education

Chapter 3
Mind-Wandering in Adolescents: Evidence, Challenges, and Future Directions

Manila Vannucci, Claudia Pelagatti, and Igor Marchetti

First studied by a handful of researchers almost 50 years ago (Antrobus et al., 1966; Klinger, 1971; Singer, 1966), in the past two decades, mind-wandering (hereafter MW) has received widespread scientific attention, with a steep rise of publication numbers in psychology and neuroscience. To date, several studies have been carried out on the functional and neural mechanisms underlying MW (for a review, see Smallwood & Schooler, 2015) as well as on age-related differences in the experience of MW (see, for a review, Maillet & Schacter, 2016).

Moreover, recently, two important conceptual and methodological advances have been reported in the field of MW: on the one hand, more fine-grained conceptual definitions of MW have been proposed and successfully applied in the studies (see Pelagatti et al., 2020 for a discussion on this topic); on the other hand, researchers have recognized the complexity of this phenomenon and its heterogeneity, and important distinctions between different kinds of MW have been introduced (e.g., spontaneous vs. deliberate MW, see for a review Seli et al., 2016a).

Surprisingly, to date only a few studies have investigated the phenomenon of MW and its correlates in adolescents, although the number of publications on this topic is rapidly increasing. Some of these studies have focused on MW as a state, directly tied and measured during a task in a laboratory setting (e.g., Stawarczyk et al., 2014), whereas others focused on MW as a trait/dispositional tendency to do MW in everyday life (Vannucci et al., 2020; Mrazek et al., 2013).

In light of the scant number of studies and their methodological heterogeneity, one may be surprised by our choice to write a chapter on this topic. However, as we show in the following, despite the current limitations, important trends are emerging

M. Vannucci (✉) · C. Pelagatti
Department of NEUROFARBA-Section of Psychology, University of Florence, Florence, Italy
e-mail: manila.vannucci@unifi.it

I. Marchetti
Department of Life Sciences, Psychology Unit, University of Trieste, Trieste, Italy

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in this new field, and the results of the studies have important theoretical and practical implications. As we review in the first part of the chapter, studying MW in adolescents may be helpful for (i) testing theoretical views about MW from a developmental perspective and for (ii) improving our understanding of the cognitive and emotional changes and challenges associated with this life stage. Moreover, as we address in the second part of this chapter, although this field is still in its infancy, future research avenues can be already identified, and some promising directions for future development can be suggested.

The Current State of Empirical Research

Looking at the empirical evidence available on MW in adolescents, we noticed that most studies has been focused on two relevant issues, highly debated in the field of MW in adults: one line of inquiry has focused on the role played by cognitive control in MW, whereas a related but partially separate set of studies has investigated the complex association between MW and negative affect/psychopathology.

Indeed, it is not surprising that researchers have begun to examine MW from these two perspectives, because attentional control abilities as well as affect regulation and regulatory competence are still developing during adolescence and the relevance and pervasiveness of attentional problems and psychopathology are a major concern in applied, educational, and clinical contexts. The two research topics are reviewed in the following sections, moving from the theoretical questions raised in the studies on MW in adults.

Mind-Wandering and Cognitive Control

When our mind wanders, our attention drifts away from the task and the environment toward internal thoughts, mainly autobiographical ones, such as personal memories and prospective thoughts, whose content is unrelated to the ongoing task. In this specific attentional state, our attention is focused on internal stimuli, which are unrelated to the task at hand and to the current situation. Self-reports of the contents of MW episodes revealed that people are usually engaged in mental time travel, mainly wandering into their personal past and future (e.g., Mason et al., 2007). According to the current concerns hypothesis (Klinger, 2013; Klinger et al., 1973), MW experiences are more likely to occur when external information is poor/uninteresting and personal internal information has greater salience and relevance, thus capturing the focus of the individual's attention. In most cases, the thematic content of MW is driven, directly or indirectly, by the individual's goals or current life concerns, especially when taking an appropriate action toward the goal is not possible.

One of the highly debated theoretical claims in the field of MW refers to the relation between this experience and cognitive control/executive functions: does MW reflect a failure of the executive control system over personal interfering thoughts, or does it reflect a redirection of resources from an external task toward internal thoughts? According to the control failure hypothesis (McVay & Kane, 2010), MW partly represents a momentary disruption of the executive control (i.e., proactive and reactive), whereas following the executive control hypothesis (Smallwood & Schooler, 2006), MW demands and recruits executive resources, and it reflects a redirection of control resources from external to internal processing. Both hypotheses recognize the contribution of the "presence and urgency of automatically generated, personal-goal-related thoughts (from the default-mode brain network)" (McVay & Kane, 2010, p. 195) in stimulating MW, but they provide opposite explanation of the role played by control processes. At the moment, neither the executive control nor the executive failure account can explain all the available data on MW in adults.

As suggested by some authors (Seli et al., 2016a; Stawarczyk et al., 2014), mixed findings may partly depend on the variety of the conceptual definitions of MW used in the studies and the heterogeneity of MW. As for the first aspect, operational definitions of MW cluster different experiences and attentional states together under the umbrella term of MW or "off-task" states. Unfortunately, as we show below, grouping different kinds of attentional phenomena, as, e.g., MW and external distractions, would likely lead to spurious, or even wrong, conclusions.

Up until recently, MW has been considered and measured as a unitary and homogeneous class of experiences (but see Giambra, 1995). However, a growing body of evidence has demonstrated the heterogeneity of MW, and in this regard, the distinction between spontaneous and deliberate MW seems to be quite relevant (see, for a review, Seli et al. 2016a; but see also Giambra (1989) for a seminal study on this distinction). The two types of MW differ in terms of the mental dynamics underlying the MW episodes: in spontaneous MW, task-unrelated thoughts capture attention, triggering an uncontrolled shift from the ongoing task to other trains of thoughts, whereas in deliberate MW, attention is intentionally shifted from the primary task toward internal mental contents, thereby suggesting a different balance of regulatory processes on the occurrence of the two kinds of MW.

In keeping with this, although the two kinds of MW are positively correlated (rs ranging from ~0.25 to ~0.50; Carriere et al., 2013; Chiorri & Vannucci, 2019), some studies have already shown that they are differently related with dimensions of cognitive control. For instance, in studies with samples of young adults, high levels of spontaneous MW are found to be associated with difficulty with attentional control and specifically with attentional distractibility and difficulties with shifting, whereas only small correlations with attentional control were found for deliberate MW (Carriere et al., 2013; Chiorri & Vannucci, 2019). Interestingly, spontaneous but not deliberate MW was found to be associated with attention-deficit/hyperactivity disorder (ADHD) symptomatology in sample of adults (Seli et al., 2015; Shaw & Giambra, 1993).

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Addressing the question of the role of attentional control in MW in adolescents is particularly relevant. Adolescence is a critical period for protracted maturation of the frontal lobes, and these brain maturational changes that continue into early adulthood play a crucial role in attentional mechanisms, and especially in sustained attention and cognitive control/executive functioning (e.g., Anderson et al., 2001; Boelema et al., 2014). In this regard, studies on sustained attention in adolescents confirmed the protracted maturation of these mechanisms and performance improvement from early to late adolescents (Carriere et al., 2010; Conners et al., 2003; McAvinue et al., 2012; Stawarczyk et al., 2014; Tamnes et al., 2012; Thillay et al., 2015). In addition, behavioral and neuroscientific studies have shown that cognitive control processes and control-related brain areas are still maturing and changing during adolescence (see, for reviews, Casey et al., 2005; Luna et al., 2015). The relevance and pervasiveness of attentional problems are a major concern in educational contexts (for a review, see Polderman et al., 2010).

In light of these developmental changes, investigating the association between MW and cognitive control in adolescence may help further clarify the role of cognitive control in MW and other kinds of lapses of attention, and it may also contribute to a more complete understanding of the attentional changes and challenges (i.e., inattention) among youth.

In their seminal study, Stawarczyk et al. (2014) addressed this question, measuring in a sample of 77 mid-adolescents (14–16 years) and a group of 87 young adults (19–26 years) attentional control abilities as well as the frequency of MW and other attentional states, such as external distraction, task-related interferences, and on-task states during a sustained attention task (i.e., Sustained Attention to Response Task, SART). As expected, adolescents reported lower and more variable performance on measures of attentional control, and they also showed lower performance at the sustained attention task compared to young adults. In keeping with this, adolescents reported being fully focused on the task less frequently than young adults. Interestingly, adolescents reported higher rates of external distraction than young adults, but the frequency of MW episode was equivalent for the two groups.

Moreover, despite MW frequency being negatively correlated with an attentional control composite score (combining the four measures of attentional control) in both adolescents and young adults, MW but not external distraction remained a significant predictor of the performance at the sustained attention task. This held even after controlling for attentional composite score. This finding challenges the control failure view of MW, and it suggests that MW cannot be entirely reduced to a failure in staying focused on the task. Moreover, this study shows the importance of distinguishing MW from other lapses of attention, as, for example, external distractions, which more likely reflect attentional control failure.

In this regard, over the last years, an increasing number of studies have shown that the different lapses of attention, such as MW, external distractions, task-related interferences, and mind-blanking, have different patterns during a task (e.g., Stawarczyk et al., 2011, 2014), they differ at the physiological level (Unsworth & Robison, 2016), and they are differently affected by healthy aging (e.g., Zavagnin

et al., 2014; Ziegler et al., 2018). Taken together, the findings suggest that these phenomena reflect distinct kinds of inattention.

More recently, Gyurkovics et al. (2020) further investigated the relationship between MW and attentional control in adolescents and examined the developmental change- in the frequency of MW, by comparing four age groups, namely, early adolescents (12–13 years), mid (14–15 years), late (18–20 years) and adults in their late twenties (25–27 years). Interestingly, in this study, the authors separately assessed and distinguished between aware MW (i.e., While doing the task, I was aware that thoughts about other things popped into my head") and unaware MW ("My mind drifted to things other than the task, but I wasn't aware of it until you asked me") experienced during a sustained attention task (i.e., SART). As expected, age-related improvements in the performance at the sustained attention task were found, with the greatest differences emerging between participants under and over 18 years old. However, although the frequency of MW was found to be negatively associated with some cognitive control abilities, the developmental changes in the frequency of MW did not support the view of MW as a failure of attentional control. In fact, early adolescents reported significantly fewer aware MW episodes than late adolescents, and numerically fewer episodes than adults. As the authors suggested, different explanations for this age affect might be advanced. On the one hand, the lower frequency of MW in early adolescents may be consistent with the executive control hypothesis: MW requires and drains executive resources, and early adolescents just do not have enough resource available to generate and maintain MW during a task. However, since the age effect emerged in the frequency of MW with awareness, we cannot completely exclude age differences in the level of meta-awareness (i.e., explicit awareness of the current contents of thoughts).

On the other hand, these results might be also explained in terms of the influence of current concerns. In fact, it is possible that the group of late adolescents, mainly undergraduate students, had more university-related current concerns, which were activated by the university setting where they were tested, compared to the other groups. It is worth stressing that, to date, a systematic investigation of the respective influence of cognitive control, meta-awareness, and personal current concerns on MW frequency in adolescents and young adults is still missing, and it represents an important avenue for future research.

As we reviewed above, the results of the studies on MW in young adults suggested that the role of cognitive control in MW may also differ depending on the spontaneous/intentional nature of MW. Recently, Vannucci et al. (2020) examined whether spontaneous and deliberate trait MW differed in their pattern of association with self-reported measures of attentional control (i.e., attentional distraction and difficulty with shifting) and depressive symptomatology in a sample of 439 adolescents and specifically tested the hypothesis that difficulties in attentional control were stronger predictors of spontaneous than deliberate MW. Interestingly, the results revealed that attentional control difficulty associated with distraction was a significant predictor of only spontaneous MW, whereas difficulty in attentional shifting was a significant predictor of both types of MW, although a stronger predictor for spontaneous than for deliberate MW. These findings confirm that MW is a

heterogeneous phenomenon also in adolescents and that conflating the spontaneous and deliberate types could lead to incorrect conclusions, although they are moderately correlated ($r = 0.60$). As for attentional control, the authors could replicate the results obtained with young adults showing that spontaneous MW is more closely tied to attentional control problems (external distractibility and difficulty in task-shifting) than deliberate MW (Carriere et al., 2013; Chiorri & Vannucci, 2019). Specifically, the results shown for deliberate MW confirm the view that MW cannot be entirely reduced to attentional control failures, and the influence of other variables (e.g., motivation, arousal, personal current concerns) needs to be considered to explain the frequency of this phenomenon.

Mind-Wandering, Negative Affect, and Psychopathology

A second, highly debated, issue in the field of MW in adults consists in the association between MW and negative affect and depression. In several studies in adults, MW has found to be closely linked with negative mood: a positive association between the frequency of MW and measures of negative mood and negative thinking has been reported (e.g., Marchetti et al., 2012; Murphy et al., 2013; Smallwood et al., 2005, 2007, Experiment 1; Smallwood et al., 2004, Experiment 3). In keeping with this, several studies show that clinically and subclinically depressed patients report high levels of MW (e.g., Marchetti et al., 2013, 2014; Smallwood et al., 2007; Watts et al., 1988) and individual differences in depressive symptoms are associated with a higher frequency of MW (e.g., Smallwood et al., 2005). As for the direction of this association, evidence suggests for a reciprocal influence between MW and mood: MW may contribute to lower mood (Killingsworth & Gilbert, 2010), and in turn, lower mood may lead to, or increase, MW (Smallwood et al., 2009).

At the theoretical level, Marchetti et al. (2016) proposed a model where MW functions as a precursor of cognitive vulnerability in individuals who are at risk of developing depressive symptoms. This depressogenic effect is expected to occur in individuals who show high levels of negative affectivity or experience intense stress, where the focus of MW becomes increasingly narrower and turns into a repetitive, self-detrimental process. Under these circumstances, MW is no longer an adaptive phenomenon, but it fosters the emergence and maintenance of vulnerability factors (e.g., rumination, hopelessness, cognitive reactivity, and low self-esteem), which likely lead to the onset of depressive symptoms.

Other researchers have proposed a partially different relationship between MW and mood, suggesting that it may indeed depend on the contents of thoughts generated during MW. Thoughts and emotions generated during MW episodes may vary widely across individuals and situations, and this variability may occur along some properties of MW, such as temporal orientation (e.g., thinking about the future vs. the past), affective valence (e.g., negative, positive, or neutral content), as well as self-referential quality (e.g., thoughts related to the self vs. others) (Smallwood & Schooler, 2015). As stated by Smallwood and Andrews-Hanna (2013), "While some

forms of thought content are linked to maladaptive outcomes including psychological distress and unhappiness, other forms highlight the adaptive nature of the experience" (p. 3) (content regulation hypothesis).

In this regard, some evidence has been reported for an association between negative mood and past-oriented MW: negative/low mood tends to skew MW toward the past (e.g., Poerio et al., 2013; Ruby et al., 2013; Smallwood & O'Connor, 2011), and, in turn, the occurrence of past thoughts during MW is associated with subsequent negative mood (i.e., Ruby et al., 2013).

Similarly, other studies found that the affective content of MW was both predicted by previous mood and associated with later mood, so that greater levels of sadness prior to MW predicted MW with sad contents and these negative thoughts exacerbated subsequent negative mood (Poerio et al., 2013). In line with this, Franklin et al. (2013: see also Schooler et al., 2014) found that the effect of a MW episode on mood was a function of how interesting the content of MW was: highly interesting MW contents were associated with an increase in positive mood compared to on-task episodes.

The multiple emotional, social, and cognitive changes characteristics of the life phase of adolescence make young people vulnerable to psychological distress and mental health problems. According to some studies, approximately one third of adolescents develop depressive symptoms, even if they do not meet the criteria for clinical depression (e.g., Compas et al., 1993). In light of this, enhancing our understanding of the association between MW and both negative affect and psychological distress in adolescents may have important implications, not only at a theoretical level but also for designing intervention to promote psychological well-being (see Smallwood & Andrews-Hanna, 2013).

In one of the first studies that addressed this issue in adolescents, Mrazek et al. (2013) found that high levels of trait MW (as assessed by the Mind-Wandering Questionnaire, MWQ) were associated with worse mood, less life satisfaction, greater stress, and lower self-esteem among high school students and middle school students (11–13 years of age). In the validation study of the Chinese version of the Mind-Wandering Questionnaire, carried out on a sample of 1331 adolescents, Luo et al. (2016) found that adolescents with a higher tendency of MW reported lower levels of self-esteem which were in turn associated with decreased life satisfaction. As the authors explained, increased MW may lead to excessive self-attention (Mor & Winquist, 2002), which may increase the risk of self-evaluation and judgment, thereby leading to negative emotions and low level of satisfaction.

In a very recent study, Webb et al. (2021) used an experience sampling method (ESM, or ecological momentary assessment, EMA) to examine the frequency, content, and affective correlates of MW in a group of adolescents with anhedonia and depressive symptoms and a group of typically developing controls, along with other goals not reported here. In the study, participants completed a resting state fMRI scan, and they received an EMA survey two to three times per day for 5 days, answering questions about their positive and negative affect, mind-wandering (frequency, time orientation, and affective valence), current activity, social context, and rumination.

The results show that adolescents with anhedonia and depressive symptoms reported a higher frequency of MW relative to controls, and they were more likely to mind-wander to unpleasant content relative to pleasant and neutral contents. Across both groups, overall MW was associated with higher concurrent negative affective even when controlling for other confounding variables (e.g., current activity, social companion, rumination). However, it is important to note that for both groups, positive affect was highest when the mind wandered to pleasant content and lowest when the mind wandered to unpleasant content. Overall, it appears that MW in adolescents is associated with negative affect; nonetheless, the content of MW and specifically the emotional valence of thoughts is a moderator of this relation, thereby suggesting that it is not MW per se that have negative implications on mood. As the authors discussed, the result that participants with anhedonia and depressive symptoms reported higher levels of MW and worse mood does not imply that mind-wandering per se may cause worse affect, in that other factors (i.e., attentional control difficulties) may have contributed to the increased levels of MW in adolescents with depressive symptoms.

In the aforementioned study, Vannucci et al. (2020) directly examined the association between trait levels of MW in daily life and depressive symptomatology, distinguishing between spontaneous and deliberate MW. The authors found that both kinds of MW were associated with depressive symptomatology, although the effect was stronger for spontaneous MW. Interestingly, this association was present even after partialling out the effect attentional control.

Due to the pioneering nature of this study, being the first one carried out on these correlates of spontaneous and deliberate MW in adolescents, we can only speculate on the mechanisms underlying these patterns of results. To date, the few results obtained on these associations with sample of adults are mixed: in a study on young adults, Seli et al. (2019) found that only trait spontaneous MW was positively associated with depression, whereas in a sample of elderly people, El Haj et al. (2019) found that both kinds of MW were positively associated with depression. On the one hand, one might argue that the association between the two types of MW and depressive symptomatology might change in relation to age, and, consequently, a person-oriented approach (such as EMA, used by Webb et al., 2021) and longitudinal study design would help delineate the direction of this association in relation to different groups. On the other hand, it might be that other phenomenological properties of MW, such as temporal orientation and affective valence, may be more relevant than the intentionality of MW in explaining the association with depressive symptomatology.

Another methodological aspect that needs to be taken into consideration is that the self-report measure of intentional MW includes items that refer to the enjoyment of the MW experience and/or generation of pleasant fantasies. Some studies have found that wishful thinking and positive fantasies about the future were associated with lower effort, performance, and well-being compared with planning and positive expectations (see, for a discussion, Oettingen et al., 2016).

Future studies are needed to further investigate these aspects and clearly distinguish MW from other related phenomena, as wishful thinking and maladaptive

daydreaming (i.e., need and excessive engagement in vivid, fanciful, and immersive fantasies), which have been found to be associated with elevated psychopathological symptoms (see, for a discussion, Soffer-Dudek & Somer, 2018).

Challenges and Future Directions

As we described above, studies on MW in adolescents have confirmed the complexity of this experience, which is far more than a failure of attention, and they suggest the necessity of distinguishing MW from other kinds of inattention (e.g., external distraction, task-related interferences). Moreover, research clearly shows that the rich variety of MW, in terms of contents (e.g., time orientation, affective valence) and mechanisms (e.g., spontaneous MS vs. deliberate MW), needs to be considered when we examine the cognitive and emotional costs of MW.

We believe that the adoption of a multidimensional perspective on MW, which has already proved to be useful (e.g., Seli et al., 2016a; Smallwood & Andrews-Hanna, 2013), would provide a greater understanding of other relevant costs and benefits associated with this experience in adolescents.

Mind-Wandering in Educational Settings

An important avenue for future research would be the identification of the impact of MW in educational and learning contexts. Studies on MW during classroom and online lessons have shown that students spend a relevant portion of time experiencing MW and the amount of MW during a lecture is negatively correlated with educational outcomes, such as poor comprehension and retrieval for the lecture material and poor note-taking (e.g., Lindquist & McLean, 2011; Risko et al., 2012, 2013; Szpunar et al., 2013). Moreover, some studies suggested that state MW mediated the relation between motivation and performance (e.g., reading comprehension; retention of lectures material) in adults. In detail, participants with low levels of motivation were more likely to engage in state MW during reading tasks and this negatively predicted their performance (Unsworth & McMillan, 2013), while another study showed that participants with higher level of motivation to learn experienced less state MW (both spontaneous and deliberate) during the lecture, and this was in turn associated with improved retention of lecture material (Seli et al., 2016b).

In the light of these costs of MW and given the role played by reading comprehension and literacy-related skills in effective learning in adolescents, this line of investigation is particularly relevant. To date, only two studies have attempted to address this research problem in adolescents (Desideri et al., 2019; Mrazek et al., 2014): state MW during a reading comprehension test was found to be associated with worse reading comprehension, whereas no significant associations between trait MW and reading comprehension and other literacy-related skills were found.

In the study by Desideri et al. (2019) in late adolescents, trait MW was a significant predictor, along with test anxiety and self-efficacy, of academic self-concept (defined as "an individual's perception of his or her learning capabilities and difficulties in different learning domains" (p. 3)). In other words, higher levels of trait MW were associated with a poorer academic self-concept. As the authors pointed out, we should also consider the "social" evaluation of MW in educational contexts. Many teachers have a negative representation of MW, in that it is considered as a factor contributing to scholastic failure, and it is likely that students whose mind often wanders received negative feedback about this experience, which in turn may lead to develop a negative representation of MW.

Mind-Wandering, Identity Construction, and Adaptive Outcomes

So far, the investigation of potential functional roles and benefits of MW in adolescents has been completely neglected. In studies with young adults, MW has been found to be associated with a wide variety of benefits, including future planning and simulation, management of personal goals, problem-solving, and decision-making (see, for a review, Mooneyham & Schooler, 2013; Smallwood & Schooler, 2015). More generally, MW has been found to contribute to the construction of a sense of self-identity and continuity across time (see for a discussion Klinger et al., 2018), and this seems to be true across culture (e.g., Song & Wang, 2012).

Given that identity development is a core task of adolescence (Erikson, 1968; Pfeifer & Berkman, 2018; Becht et al., 2018), the contribution of MW to the exploration of the emerging identity and to self-related processes as self-verification and autobiographical planning is worth prioritizing in investigations in adolescents. In this regard, a multidimensional evaluation of MW, which considers the spontaneity/intentionality of MW as well as other qualitative aspects of the contents of MW episodes, could be quite promising, in order to identify effective ways in which MW may support the development of a strong identity.

Moreover, studies on spontaneous and deliberate MW in adults have provided evidence for a constructive and functional value of deliberate MW. For example, high levels of deliberate MW are found to be positively associated with originality at a divergent thinking task and with positive-constructive daydreaming style, openness, and self-reflection (i.e., adaptive kind of inspection of one's own thoughts and feelings), whereas levels of spontaneous MW are found to be associated with low originality and with high levels of self-rumination (i.e., maladaptive, persistent, inflexible, and inappropriate self-consciousness) (Agnoli et al., 2018; Marcusson-Clavertz & Kjell, 2019; Vannucci & Chiorri, 2018). In a similar vein, studies investigating the contents of MW have shown that engaging in thoughts that are personally interesting is associated with more positive mood and, under some situations, it may be an effective escape from boredom (Mooneyham & Schooler, 2013).

Capturing the Complexity of Mind-Wandering

More generally, a comprehensive (i.e., both state and trait MW) and balanced (i.e., costs and benefits) investigation of complexity of MW in adolescents is desirable, not only for theoretical reasons but also for designing adequate educational strategies/psychological interventions. By doing so, we could aim at reducing the learning and emotional costs of MW, without reducing its potential benefits. The ultimate goal is not to find an antidote for MW, but to minimize the negative outcomes and possibly "to allow and foster MW potential" (Desideri et al., 2018, p. 12).

This ambitious goal could be met only if methodological innovations follow closely. Research on MW in adults has greatly benefited from the use of the "strategy of triangulation" (Smallwood & Schooler, 2015), whereby self-reports, behavioral measures, and physiological measures are combined together in the same study to make inference about the attentional states experienced during a task. Neuroscientific techniques (e.g., fMRI, event-related potentials, eye movements, and pupillometry) have provided a great contribution to our understanding of the remarkable mental activity involved in MW, which entails complex higher-order neural mechanisms, and to distinguish MW from other kinds of attentional processes. Using a joint behavioral-pupillometry paradigm, Pelagatti et al. (2018, 2020) recently started addressing the question of the duration of MW episodes, providing objective measures about the temporal unfolding of MW. To date, with a few exceptions, research on state and trait MW in adolescence has relied on self-report and, in some cases, behavioral measures of MW. Identifying reliable behavioral and physiological measures of MW and other attentional states in adolescents and comparing these measures with the ones reported in young adults may help conceptualize MW and its costs and benefits in a developmental perspective.

Conclusions

Although the investigation of MW in adolescents is still in its infancy, the few studies on this topic have already started addressing some relevant and controversial issues, related to the association between MW and cognitive control and MW and negative mood. Overall, the results of the studies show that MW in adolescents is far more than a failure of attentional control and that it is not detrimental per se. Moreover, in line with the evidence coming from studies on MW in young adults, the results of the studies with adolescents demonstrate (i) the necessity of a clear operational definition of MW, which distinguishes MW from other kinds of lapse of attention, and (ii) the usefulness of a multidimensional approach to MW, based on the recognition of the heterogeneity of MW, in terms of both mechanisms and contents. In this regard, although this field of research is a relatively new one, we could identify some lines of research and future developments. Our suggestions for future research are not the only ones that might improve our understanding of MW from a

developmental perspective, but they may significantly contribute to build a more balanced view of MW and its complexities (i.e., costs and benefits), with clear implications for both educational and psychological interventions.

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Author Queries

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Queries	Details Required	Author's Response
AU1	Please provide details of Chiorri and Vannucci (2019), Carriere et al. (2010), Marchetti et al. (2012), Mrazek et al. (2014), Klinger et al. (2018), and Desideri et al., 2018 in reference list.	
AU2	Please provide opening quote in the sentence starting "While doing the task…".	