Doodling: is it a distraction or benefit?

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This study was instigated by two factors: like many others (Kukawa, 2011; Laventure, 2011; Ruhland, 1993; Schott, 2011) doodling whilst listening has been common practice for me throughout my career, and I have also used it increasingly within my practice in order to enable trainees to modify their attitudes to art and design. Personally, it enables me to focus more explicitly upon what is being said, and secondly, trainees have responded that despite having negative feelings initially towards art during their training, doodling has enabled them to realise that, due to there being no expected outcome, they felt less threatened and actually expressed some enjoyment. These two factors will be explored within this study using research and literature to investigate how and why doodling has this impact, and whether it has a potential place in educational practice.

The majority of people at some time will have seen a doodle, indeed many may have made such drawings. Doodlers appear to be individualistic, rarely copying each other. There has been a historical practice of doodling; Dürer, Erasmus and Dostoyevsky were famous exponents of the doodle, as were the many anonymous clerks whose work intrigued Gombrich (1999) the art historian who published a study of the artform itself. There has been some lay literature on the subject, much devoted to the interpretation of the doodle, based upon the premise, unsubstantiated, that such doodles reveal traits such as personality and psychology of the said individual. However, these can only be subjective, so I shall explore studies that have a more objective stance.

Why doodle?

Doodling has many purposes. It can focus the attention by fulfilling the craving for symmetry in a chaotic world and can also be used to assess the effectiveness of college instructors or help define comfort or what is comforting (de Guzman et al., 2007). Depending on the skill of the doodler, the doodle may even create backtalk, that is a verbal explanation that accounts for a mistake made in the doodle (Goldschmidt, 2003). Doodles can be an outlet for the need to be active when students are forced to be inactive in a confined space. The tension between the desire for activity and the need to be still is resolved through doodling and allows the student to focus on the class lecture. This particular function of doodling speaks to the relationship between doodling and attention.

Defined as an aimless scrawl made by a person whilst their mind is otherwise applied (Oxford English Dictionary), doodling is often seen as a sign of boredom (Smallwood & Schooler, 2006). This has been evident during my career, when asked whether I have actually been listening during meetings- the perception of others appears to correlate closely to this thought. Harris (2000) outlines that boredom is viewed as a state of mind, generally linked to a negative affect; a term, which in this case, refers to a person’s emotional state or mood at any given time (Do & Schallert,

2004; Harris, 2000). According to Barron et al (2011), when one is bored, the mind begins to wander from the task at hand. This suggests undesirable features, such as a child in a school environment who has several demands upon their attention at any given time, tuning out of a discussion and hence making it difficult to learn from what is being considered (Kercood & Banda, 2012; Kam et al, 2011; Smallwood et al, 2008).

Impact upon cognitive processes

However, a person is more likely to learn from a discussion if they are focussed on content (Do & Schallert, 2004) and they suggest doodling may be useful when used explicitly to prevent wandering minds. Enabling one to doodle as a secondary activity may actually boost performance- or within my workshops, foster relaxed attitudes thus reducing tension and negative attitudes. It has been suggested that it stabilises thoughts, thus cutting down on the potential for spontaneous brain activity, sometimes referred to as daydreaming (Smallwood & Schooler, 2006; Teasdale et al, 1993), effects that are proven to be detrimental to learning (Seibert & Ellis, 1991; Smallwood et al, 2003; Smallwood, Fishman & Schooler, 2007). Smallwood et al (2007) suggest that people who would benefit most from doodling as a concentration building activity are more likely to let their minds wander. Schott (2011) considers the conundrum that all research has to surmount- that during the act of doodling, the individual's focused attention is by definition partly engaged at least with internally generated thoughts and not on the task itself. He concludes that whatever brain processes are enlisted during the task they appear to be well established as the doodles produced often have a consistent form: geometrical patterns, faces, scenes, and these features suggest that the underlying cerebral processes are both specific to that individual and stabilise over time. There is variability- some individuals never doodle, whilst others do so only rarely; however this would move into a separate area of inquiry.

Given therefore that a positive environment (Banks, 2014; Hayes, 2012) and the mindset of the person involved (Do & Schallert, 2004; Fredrickson, 2001; Pekrun et al, 2002) both affect the quality of any outcome, it is important to consider what benefits accrue. An adaptable, flexible environment is desirable for those inclined to doodle (Friedman & Abramson, 2013) although the impact upon those that are not must also be a consideration. Certain scenarios suggest that doodling may be the result of boredom, aimlessly sketching patterns or symbols unconnected to the current task, which would not be the desired effect; this is what is perceived as 'day dreaming' (Andrade, 2009). The question that needs to be considered is whether the act of doodling actually impairs performance by detracting from the task or whether it actually improves performance by aiding concentration (Do & Schallert, 2004) or maintaining arousal (Wilson & Korn, 2007). Boredom and daydreaming are commonplace in many contexts (Harris, 2000; Smallwood & Schooler, 2006) and some studies have identified that dual tasks can identify specific outcomes, but the effects of boredom can create inaccuracies in results.

There is little research in this specific area, as much focuses upon general issues within cognitive psychology, however Andrade (2009) conducted a study in order to ascertain whether doodling can be determined as an aid to concentration. Through simple tasks of shading specified prepared shapes whilst listening to telephone messages, participants were monitored for their accuracy of

recall of information. Free doodling was not included, as it was felt that participants felt self-conscious; the shading was intended to enable them to adopt a sense of absent-mindedness which free doodling would inhibit. Results indicated that those individual participants who shaded were able to recall information in more detail than those with no con-current task, although it remained unclear whether doodlers simply noticed more of the names in the message or whether it aided memory directly by deeper processing of the material. Thus these tests may seem inconclusive, however significant methodological factors may have impacted upon the beneficial effect: participants were already mentally tired upon arrival and instructions suggested that the tape would be 'dull' in order to discourage them from trying to find interesting features. They were told that the actual task of doodling was to 'relieve boredom' and therefore naturalistic doodling may not have the same impact upon concentration.

Further perspectives

Research from another sphere, technology, (Karlesky & Isbister, 2013), based upon the premise that fidgeting can be placed in the same sphere as doodling, suggests that there is a clear link between affective state and effectiveness in mental processes (Cloud, 2009; Garger, 1990; Goldberg et al, 2002), as both modulate levels of focus on a given task. There have been several practical outcomes of such research; Doodle Space paired camera phones and public displays for collaborative expression (Zhong et al, 2009), doodles have been utilised as password mechanisms (Goldberg et al, 2002). Karlesky & Isbister (2013) considered the impact of affective states on cognition, finding that these range from mildly positive affect promoting creativity and cognitive flexibility (Ashby et al, 2002; Isen, 2003) to anxiety demonstrating an increased focus and attention (Park, 2011). Cloud (2009), Garger (1990) and Mason et al (2007) develop this consideration with reference to hyperactive and ADHD children where it has been hypothesised that fidgeting is a natural coping mechanism employed by the body in order to promote natural stimulant release, enabling the mind to focus more explicitly on a task. This resonates with my experience; personally I am aware that if I am unable to doodle for some reason when listening to others, I do fidget more than usual. In my teaching experience I taught many children that had diagnoses of ADHD or simply had issues with long term concentration, and I encouraged these children to use rubber balls or other 'widgets' to enable them to manipulate during lessons. There was the potential for such items to be misused or create disruption, but I rarely found this to be the case- indeed often these children appeared to be able to focus more closely than if deprived of this facility. Of course this is anecdotal, but suggests that there might indeed be some worth in further consideration of the aspect of doodling. Schott (2011) considers that the brain 'default network' appears to establish a baseline of cognitive function, which engages at times of boredom, impatience and indecision, therefore indicating that there might be parallels between doodling and other stress relieving motor activities. A note of caution arises here; Hembrooke and Gay (2003:1) found that students who have open laptops, whether used for social purposes or to look up material related to the lecture, "suffered decrements on traditional measures of memory for lecture content". This correlates with findings that an overload of stimulation or multitasking can have a negative impact upon concentration (Lee, Lin, and Robertson, 2012); when the cognitive load is too high, the brain's computational capacities become compromised. Basically, when one's attention is pulled in multiple directions, one cannot think straight (Rosen, 2008). So perhaps the level of doodling might be considered to have a low level impact and hence does not compromise the brain in this way.

Kercood & Banda (2012)'s study, although having a wider perspective, investigated the effects of physical activity on performance (listening comprehension) and one of the alternative tasks to their therapy ball activity was doodling. Their findings suggested that both conditions were equally effective with children; all the participants answered more questions compared to the baseline group Statistics in the US estimate that 1 in 20 children, and approximately 5.9% of school age children worldwide, have a diagnosis of attention problems, and this will impact upon Higher Education accordingly if those children choose that path (Faraone et al, 2003; Polanczyk et al, 2007). Therefore, in practice, one might imply that rather than reprimanding students who fidget or doodle, perhaps it might be beneficial to include physical activities before or during tasks that require concerted listening. Research (Hollar et al, 2010; Donnelly et al, 2009; Chomitz et al, 2009) agrees that by enabling children to engage in some form of physical activity before or during a task, improvements are made in summative assessments and also in time taken in which to complete tasks. Kercood & Banda (2012) expanded upon this and found similar outcomes. They based their research upon the Optimal Stimulation theory (Kercood et al, 2007) which hypothesises organisms will initiate stimulation-seeking activity to achieve a stimulatory state that might be described as homeostasis (Hebb, 1955). Therefore individuals, such as those with ADHD, can improve their performance in routine tasks through the provision of additional stimulating activities, such as doodling (Zentall, 2006).

Multi-tasking

It is important to explore the mechanisms underlying the effect of doodling upon concentration. The dominant theory that has been used for many years has been that designed to account for how we temporarily manipulate and store information during thinking and reasoning tasks is the Working Memory Model (Baddeley, 2000; Baddeley & Hitch, 1974). This model helps us to understand how memory processes are used during day to day familiar activities, or during more demanding tasks that require greater effort and new thinking. The brain is not infinite, it has a limited capacity to store and process information, as a result there is a limit to how many activities can be processed at the same time. Some tasks actually interfere with each other as they require the same resources within the brain. This identifies some important points that relate directly to the thought of doodling whilst carrying out other tasks, most specifically listening: the system deals with temporary storage and so deals with things we are doing right now. Secondly, the system is under attentional control, indicating that, in most instances, we choose where to direct our attention. Finally, the system underpins our capacity for complex thought, making it fundamental for any type of higher order thinking or reasoning task. In this way, working memory can be viewed as the foundation for most cognitive processes that rely on temporary memory storage. The most important component of the model is a system for controlling attention, known as the 'central executive', used to ensure that working memory resources are directed and used appropriately to achieve the goals that have been set. There are also two temporary storage systems. One is for holding speech-based information, known as the 'phonological loop'. The second is for holding visual and spatial information and it is known as the 'visuospatial sketchpad'. These are the two that may be the most important where doodling is concerned. These two storage mechanisms are regarded as 'slave subsystems', because they do not do anything beyond holding information in a relatively passive manner. The real 'brains' of the working memory system is the central executive

(Baddeley & Hitch, 1974). This original model was revised when it became apparent that criticism required a need to account for the effects of long-term knowledge (all of the stored information that we know about the world) on working memory, which had not been considered previously. The additional 'episodic buffer' provided a link to long-term memory; a way of integrating information from all of the other systems into a unified experience; and a small amount of extra storage capacity that does not depend on the perceptual nature of the input (Baddeley, 2000).

This phonological loop is a temporary store for heard information, particularly speech. It represents the storage system responsible for 'phonological short-term memory' (PSTM). It is passive and time limited, indeed the memory fades very rapidly, approximately two seconds worth of heard material. The second temporary system is the articulatory rehearsal mechanism which is used to recite the information, which is then saved in PSTM, and the process repeats itself. In adults this tends to be done internally, although children frequently have to articulate their thoughts aloud in order to 'internalise' them. A second function, known as 'phonological/verbal recoding' (or 'phonological/verbal coding') is a process by which information presented in a visual form (printed words, printed letters/numbers, pictures) can be converted into speech. This might represent a link to doodling, although Baddeley goes on to explain that this recoding only works if there is a physical representation that can be labelled, e.g. a house, which can be labelled explicitly. As many doodles do not appear to represent any specific figure, this might suggest that this is not after all significant. The same might be said for the visuospatial sketchpad as this also only holds information for a short time, and refers to that information that is observed, not actually created.

However, Baddeley & Hitch (1974) do suggest that there is a potential link to the central executive when conducting dual tasks: This is an approach where a participant is asked to do two things at once, and looking at the 'cost' to performance of combining the two tests together. The role of the central executive in dual task performance is to coordinate performance on both tasks and allocate appropriate amounts of attention when and where required. This has significance for doodling whilst focusing upon another task. Often, the participants are required to focus more on successfully carrying out one task (primary task/ listening) than the other (secondary task/ doodling), and executive control can be used to allocate more attention to the 'primary' task. These higher-level decision processes relevant to the overall conduct of the task are believed to be carried out by the central executive. This, I feel, is quite significant. The central executive, whilst not able to store data, is the key component in that it controls the allocation of resources within the working memory system by focusing, dividing and switching attention as necessary. Hence, a person is able to simultaneously listen, watch and doodle concurrently, with no appreciable loss of data.

This contradicts with Hembrooke and Gay (2003) who investigated the multi-tasking of using laptops whilst listening to a lecture. Two groups of students (one using laptops to browse, search or engage in social networking, the other keeping their laptops closed) heard the same lecture and tested immediately afterwards. Students in the open laptop condition suffered decrements on traditional measures of memory for lecture content. This mimics different variations that have been investigated including different modalities, the same modalities, task difficulty, the effects of

practice, the effects of either the primary or secondary task on performance, and testing during encoding or retrieval (Baddeley et al, 1984; Naveh-Benjamin et al, 2000; Johnson et al (1970); Spelke, Hirst, & Neisser (1976). Almost without exception performance on one or both task suffered a decrement as a direct result of having to perform the two tasks simultaneously. This is a concern from my perspective; it presents a quandary as this suggests that enabling, indeed encouraging, students to doodle whilst participating in lectures and seminars may not be as beneficial as first thought.

Limitations on cognitive processes

Research in another area, which also builds upon the notion that there is a fixed amount of cognitive resources upon which the processor may draw, focuses on delineating the specific sub processes involved and how each may be compromised at every step in the process. Lang's Limited Capacity Model (LCM) (2001), relies heavily upon cognitive constructs as she applies it to mediated learning contexts. The model outlines the step progression of the cognitive processes involved in processing information. Conscious and unconscious mechanisms determine what information is selected for encoding. Once in short term, or working memory, previous knowledge is activated and linked with relevant aspects of the new incoming information. Memory for the new information is created through associations between the new and existing knowledge, or by recurrently activating and linking the bits of new information over time. The number of related associations between new and existing information determines memory strength.

However Hembrooke and Gay's research (2003) found that content would seem a likely culprit for introducing differences in the conscious mechanisms involved in selective attention, therefore this might suggest a parallel between laptop 'surfing' (where the content is perhaps superficial) and doodling, where the activity requires minimal concentration. Their results showed that despite some apparent loss of information during the immediate subsequent test, that due to the prevalence of multitasking in the overall context of their learning, the average grades achieved in summative assessments showed that they did not diminish their scores. There is the possibility that over time, students became increasingly adept at multitasking in the classroom setting. This might correlate with Mason et al's assertion (2007:1) that when 'mind-wandering', by using both thought sampling and brain imaging to investigate, they could determine it is associated with activity in a default network of cortical regions that are active when the brain is "at rest." The default network is minimally disrupted during passive sensory processing (doodling) and attenuates when people engage in tasks with high central executive demand (listening), which matches precisely the moments when the mind is most and least likely to wander.

Focus on doodling in practice

There has been research, apart from that of Andrade, which focuses specifically upon doodling which is of explicit interest from my viewpoint. Aellig et al (2009) express the view that student doodling is a form of self-expression that may divert attention from course content in an educational setting. The purpose of their research was to determine the extent to which student attention span and doodling can be used to predict how much students learned from an

educational video. Students with shorter attention spans were expected to have more complex doodles and perform lower on the video content quiz at the end. However, the results did not support the hypothesis that there are relationships among doodling, attention, and number of correct video items. Virtually all scored 100% in the test. While students watched the educational video, they had been given the opportunity to take notes, which was identified as a necessary component of the classroom experience (Badger et al., 2001). Of the 34 participants, 24 took notes and only 6 people doodled, despite the fact that the video content was moderately interesting and challenging and the participants were not directly encouraged to take notes. This may have been due to contextual factors (the students in the study were from an environment where doodling was discouraged, therefore many did not actually take the opportunity to do so) so it would be interesting perhaps to follow this line of research further with a different cohort with fewer inhibitions in order to ascertain whether there is indeed such a correlation. Perhaps it suggests that one should establish a cultural norm that doodling is acceptable in such contexts.

In the seminar context students are required to focus their attention on relevant sources of information, for example listening to information from the tutor and processing that information either externally in the form of note-taking or internally through memorising data (Higgins & Turnure, 1984). By integrating such information from the external environment with their own internal representations, they become successful learners (Smallwood et al, 2007). However it is during these times that certain participants may begin to lose concentration, for possible reasons explored earlier. Barron et al (2011) investigated the inability to avoid distraction, finding that there appeared to be a general reduction in attention to external events regardless of their relevance - the decoupling hypothesis. This view assumes that certain classes of mental processes are common to self-generated and externally maintained trains of thought (Smallwood & Schooler, 2006) and simply extends this assumption to the internal/external dimension. Mental processes are described as decoupled when the onset of their activity is not directly related to an external event. Hence one could suggest from this that the act of doodling is decoupled from the main activity, listening, and has no significant impact upon it. As a result, doodling could be encouraged in order to reassure students that it can be a pleasurable, non-threatening activity used alongside the key activity, which in turn might raise self-esteem and enhance a positive attitude to art and design.

However, mind wandering can use mental energy (Singh & Kashyap, 2015) and this might create an adverse effect upon those tasks that compete for such resources (Seibert & Ellis, 1991; Smallwood et al, 2003; Smallwood, Fishman & Schooler, 2007). Although considered perhaps as a low level external distraction (Hembrooke & Gay, 2003) there remains the potential for internal distraction, and this must be accounted for when considering whether doodling should be encouraged. Additionally, there is also the consideration that those who are doodling might also provide an external distraction to others. As suggested previously, periods of task unrelated thought do reduce the processing of task- relevant information (Kam et al, 2011; Smallwood et al, 2008), hence it may be that an environment where doodling is encouraged might not be an effective learning environment. However research also appears to indicate that even children as young as eight experience no detrimental effects on task performance with distractions present (Higgins & Turnure, 1984). Although dated, it might suggest that one might learn even when

distracted minimally from the main task as well as one might if fully focused. They point out that factors that must be considered here include intellectual ability (which is a wide variable potentially), difficulty of main task or intensity of distraction (doodling).

In spite of negative connotations that are identified with doodling generally, there appears to be a positive relationship between the physical act of doodling and ability to focus. Karlesky & Isbister (2013) suggest the advantageous possibility of using a secondary concentration boosting activity to enhance the primary. Both Karlesky & Isbister (2013) and DiProperzio (2011) refer specifically to the act of doodling: they state that it has been proven to increase attention and improve recall because the physical act of doodling cuts down on the mind wandering suggested by Mason et al (2007) and does not impact upon the performance of the main task (Andrade, 2009; DiProperzio, 2011).

Andrade (2009) suggests three hypotheses when discussing the underlying relationship between doodling and concentration. She states that doodling simply helps maintain the mind at an optimal level for learning by reducing the high levels of spontaneous brain activity, which is often associated with boredom (London et al, 1972). However it might be that doodling adds an additional dimension to the primary task, increasing the level of difficulty and therefore reducing the potential for the mind to wander. Thirdly, it is possible that a continual but small central executive load detracts minimally from the primary auditory task. The doodling itself employs a small part of this capacity and is therefore sufficient to prevent the greater impairment to performance that would have occurred if working central executive resources were released for the act of daydreaming (Andrade, 2009; Baddeley, 2000; Baddeley & Hitch, 1974).

Environmental factors

Observations by Do & Schallert (2004) add strength to these hypotheses, noting that if students 'tuned out' of a discussion, they might use specific strategies to return to the current main activity, for example specifically using doodling to do this. Therefore there may be additional benefits to the act of doodling, beyond my original desire to enable students to use it in order to create a positive enhancement to their self-esteem. This suggests that the environment itself may be an important factor. Coultas (2007) describes settings where the issue is maintaining students' attention in the first place, however such situations can be avoided with forethought. Friedman & Abramson (2013) discuss 'technical success', a term used to describe the preparatory actions one might take to ensure the optimum learning environment for students, comparing the environment to that of a shop- carefully thinking about where products(resources) would be placed in order for the best reward. Positioning of students is an important consideration; are they able to focus on the speaker/ whiteboard, as well as have the wherewithal to doodle if wished? Environment is a focus of much research (Banks, 2014; Friedman & Abramson, 2013; Fraser & Pickett, 2010; Watkins et al, 2007) and concur that it has a considerable impact upon the students.

Cowley (2010) and Friedman & Abramson (2013) refer to the consideration of those whose minds have a tendency to wander and suggest that such students should have the facility to doodle (or

fiddle with a given object such as plasticine), and recommend the provision of such materials. This concurs with my practice currently- the provision of paper covering the tables in the art room and a variety of pencils available if students wish to doodle, but at the same time ensuring that they are all have good visibility of myself and the whiteboard. Through providing such a flexible environment ensures participation, co-operation and focus (Pianta, 1999), enabling greater willingness to take risks and accept challenges (Birch & Ladd, 1997). The consideration of equal opportunity, as investigated by Lenzi et al (2014) who explored how class dynamics might be impacted upon through perceived unfair treatment such as peer interactions based upon power, dominance or aggression, would not be a factor in my practice, as all students would have the wherewithal to doodle if they so wished- there would not be any perceived favour and those that did not doodle would not perceive any form of penalty.

Singh & Kashyap (2015) state that it is possible to simultaneously produce simple unfocused drawings whilst one's attention is otherwise occupied, corresponding with Andrade (2009). Although reference to doodling specifically is relatively limited, parallels might be drawn to the playing of background music during focused learning activities (Chalmers et al, 1999; Hallam & Price, 1998; Schott, 2011), also an example of multi-tasking working to benefit learning. Doodling itself is an area difficult to quantify in terms of impact upon concentration and hence learning; Harris (2000) adds to the complexity here by stating that reported boredom may point to a metacognitive judgment about one's attentional activity, adding that those claiming to be bored might not necessarily be those experiencing the highest levels of distraction. Therefore raising questions as to who might benefit most from a secondary concentration boosting activity.

The impact of emotional response

There is an additional element that perhaps deserves consideration; it is acknowledged that the learning process is often accompanied by some form of emotion (Hascher, 2010; Op't Eynde & Turner, 2006). Do & Schallert (2004) describe emotions as intense, short-lived affective states, multi-layered and hidden from outside observers- therefore they are difficult to measure. Educational psychologists have become increasingly aware of the importance of affective states and their relationship with cognitive and motivational processes in learning situations (Meyer & Turner, 2002; Turner & Schallert, 2001; Weiner, 1992). The term 'affect' or 'affective process' refers to a broad, inclusive state encompassing emotions, mood and aspects of motivational processes (Do & Schallert, 2004). This is an area that I feel is important to consider in my specific context- I must be careful to think about how one student varies to another intrapersonally, particularly changes or occurrences within each individual (Hettena & Ballif, 1981). Emotions are personal responses to stimuli- the willingness or ability approach a task will impact upon achievement Do & Schallert, 2004). There is empirical evidence (Fredrickson, 2001; Pekrun et al, 2002) that positive emotions facilitate learning. This is crucial to my scenario- if doodling can reduce inhibitions and enhance confidence, then it follows that learning will be enhanced also. As evidenced by Do & Schallert (2004) explicitly with regard to doodling- they found students 'tuned out' when affected by boredom or frustration, in order to disengage from negative emotions. However they reported they could re-focus after a period of doodling, contrasting to evidence that suggests doodling results from a wandering mind- perhaps doodling has an explicit purpose in actually re-engaging the brain after all.

Like myself, Ruhland (1993) describes how he doodled incessantly at school, often resulting in being penalised for doing so. However he states that despite this drawing-while-listening was a delight for him. Hence doodling for enjoyment may benefit learning; although it might potentially contain an element of disruption, the benefits would seem to over-ride this (Alberto & Troutman, 2006; Alstot & Alstot, 2015; Do & Schallert, 2004). As a result, my practice will continue to enable those students, that wish to do so, the resources to doodle, and indeed I will continue to do so myself, as there is no completely negative impact that I can perceive from this study, yet there may indeed be many benefits, such as the element of enjoyment which has been seen to beneficial in its own right.

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