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Review

Spontaneous thought as play: the value of fictional goals in the default mode network

Gaia Molinaro[1,2] and Moshe Bar[3]

Given its prevalence in our wakeful mental activity, spontaneous thought (ST) has been attributed several roles in cognition, most of which engage the brain's default mode network. Among the benefits of ST is its ability to support the proactive simulation of possible future scenarios, including situations that, prima facie, may seem frivolous, futile, or simply unlikely. By drawing an analogy between ST and children's play, we propose a substantial role for what might otherwise seem like useless mental activity. In children's play, 'fictional' activities have been argued to hold inherent value, as they hone the capacity to generate new plans and ideas — even if never pursued — and the ability to generate increasingly accurate simulations. We suggest that ST similarly provides a platform for the simulation of goals and scenarios outside the boundaries of what is likely or even feasible in the given context, facilitating learning and innovation. In this capacity, ST supports human intelligence and mental well-being. We discuss the implications of our proposal for the understanding of ST and its underlying neural circuitry.

Addresses
[1] Department of Psychology University of California, Berkeley, USA
[2] Neuroscience Department University of California, Berkeley, USA
[3] The Leslie and Susan Gonda Center for Brain Research Bar-Ilan University, Israel

Corresponding author: Bar, Moshe (moshe.bar@biu.ac.il),
Molinaro, Gaia (𝕏 @gaia_molinaro),
Bar, Moshe (𝕏 @moshe1bar),
Molinaro, Gaia (@gaiamolinaro.bsky.social)

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Introduction

Between 25% and 50% of our lives are spent thinking about topics that are largely detached from our immediate activities and surroundings [1–3]. Many of these thoughts fall under the category of spontaneous thought (ST), which includes mind wandering, daydreaming, and fantasizing [4,5]. ST is largely supported by activity in the default mode network (DMN) [6–8], although other brain areas are also involved [9,10]. Although ST is an inherently elusive concept [11], it can be characterized as relatively free of deliberate constraints implemented through cognitive control (e.g. intentionally bringing our attention to a boring class) or automatic constraints driven by affective or sensory salience (e.g. paying attention to a crashed car on the side of the road despite our best efforts not to) [12,4,13]. According to the dynamic framework of thought [4,13], ST implies more cognitive control than dreaming but less than goal-directed thought, and, unlike ruminative and obsessive thoughts, it is not tightly constrained by emotional stressors [5].

While psychologists have long wondered how, why, and when the mind wanders [14], ST only became a subject of scientific study relatively recently [15], when it was primarily addressed as a failure to concentrate and a disruption to purposeful behavior [16,17]. Despite its initial treatment, ST should be less prevalent if it were exclusively disruptive [18]. In fact, while occasionally deranging present activities, ST may positively impact cognition on a broader scale. For instance, ST is often future oriented, which helps us simulate and plan for upcoming events [18–20]. It also reiterates experienced scenarios, supporting memory consolidation in the process [21,22]. As much as 70% of ST has been shown to involve simulating situations that include other people [23], suggesting that it may play supporting roles in social interactions [24]. Some findings suggest that planning and imagining movements, as may occur during ST, can lead to improvements in physical activity [25–27]. Because ST frequently involves the mental simulation of past and planned activities [18,28,29], often engaging the same brain regions as their actual execution [26], it may benefit our physical performance when we eventually enact those activities. Although initially thought to correlate with negative feelings ([2], but see Refs.

[30,31]), ST can act as a temporary relief from immediate concerns, thus improving mood [32,33]. By enabling broad associations across concepts [34,35], ST also supports the discovery of creative solutions [36,35,37]. ST may also initiate the search for more rewarding or important activities by evaluating alternative scenarios when current tasks are either too easy or too difficult to achieve [38,39].

Despite all these adaptive roles, ST often appears dedicated to thoughts that are unrelated to immediately relevant scenarios, and its untethered, free-flowing characteristics remain difficult to reconcile with a view of ST as a beneficial cognitive process. Here, we connect ST with children's play to propose that seemingly wasteful aspects of ST, which center on goals that may not be pursued in real life, serve important cognitive functions. While we recognize that several aspects of ST likely contribute to creativity, planning, problem-solving, and positive mood [17,19], this opinion piece focuses on the role of goals simulated in ST and their impact on other cognitive processes. A recent perspective highlighted the beneficial aspects of goal setting in and of itself, even when disconnected from any concrete endeavor, as a way of extending previous knowledge and supporting innovation through associations [40]. Previous work also suggested that humans mostly produce and pursue such arbitrary, unrealistic goals in playful behavior (prominent in childhood) [41]. By drawing an analogy between ST and play, we propose that, through ST, 'fictional' goals continue beyond development and that ST and play share a role of support for the ever-improving simulation of imagined goals. As such, ST serves as a valuable platform for cognitive control, innovation, and knowledge integration throughout the lifespan.

The value of fictional goals

Goals are core to higher-order cognition, enabling flexible behavior by helping reduce the complexity of incoming signals, supporting planning, and contextualizing information [42,43]. Goals can shape internal representations to align with desired states [44,45], prune the action space to favor behaviors that serve a pre-established objective [46], elicit attentional shifts [47–49], and shape our appraisal of events, attributing rewarding functions to outcomes that match the present goal [50–52]. The dynamics of goal selection and pursuit are complex and far from fully understood [53]. Most existing research focuses on instrumental goals people generate and, at a minimum, consider pursuing in real life. While setting (and studying) goals of this sort is useful [42], recent perspectives highlight the importance of seemingly more frivolous goals, which individuals temporarily set and never plan to pursue [40].

Such 'fictional' (as opposed to immediate, actual) goals are a central property of children's play [40]. In play, goals are valued for the rewarding struggle they enable and the skills they call for [54,55], an aspect emphasized by Bernard Suits as he first suggested that playing a game involves 'the voluntary attempt to overcome unnecessary obstacles' [56]. While linking obstacles to fun seems counterintuitive, people willingly engage in painstaking puzzles, draw arbitrary lines for a ball to cross or avoid, and invent stories about monsters to defeat — all in the absence of external rewards. In other words, playing entails entering a state where a fictional goal and an associated state of affairs are temporarily accepted for the sake of a game [56]. The fictional goals set during play serve important functions in human cognition, particularly by supporting the development of planning abilities and the generation of new ideas [40] — both central aspects of human intelligence.

We propose that some benefits conferred by fictional goal setting in play are mirrored in ST. Although play and ST have traditionally been studied in separate fields, parallels between them could help expand current views on the role of ST in cognition. For instance, both play and ST involve predictive processes that help us prepare for later challenges by mimicking possible scenarios, both support creative problem-solving, and both have ties to well-being and positive mood [35,57]. In the next section, we elaborate on the analogy between play and ST to propose that, similar to play, ST functions as a platform for honing our ability to set goals, solve problems, communicate, expand our knowledge, and beyond. We will also highlight some important differences between play and ST, including the fact that while play is predominant in early childhood, ST persists at any age, meaning it could afford the same simulation capabilities well into adulthood.

Analogies between spontaneous thought and play

Several adaptive roles have been attributed to play [41,57]. For example, play involving multiple parties can help define social hierarchies and strengthen relationships within a group [58]. Types of play that involve physical activity may function as motor training, whereby animals learn motor skills relevant to their survival, such as pouncing, hiding, running, and grabbing [59]. Some uniquely human forms of play entail the unfolding of imagined scenarios [60], which may support reasoning about the mental states of others [61,62], counterfactual events [63], and surprising situations [57,64]. Most of these functions of play relate to its mimicking reality, thus preparing the young for their future endeavors. However, a recent shift in focus has highlighted how play might also be valuable when it deviates

from reality, rather than modeling it. By establishing temporary, imaginary goals that manipulate the mapping between external stimuli and internal rewards, children link disparate ideas and generate novel insights [41]. Despite obvious differences (e.g. play usually being a physical behavior and ST being mental), play and ST share several features and could be interconnected [65]. We first identify analogies between ST and play. While several links between the two are worthy of exploration, we focus our analysis on the role of goals in each and suggest that a process of fictional goal generation and pursuit, similar to the one observed in play, also occurs in ST. This hypothesis could improve our understanding of ST and its nuanced impact on human cognition.

No universal definition of play currently exists (and perhaps never will [66]). To draw the parallels we propose between ST and play, we follow Gray's [67] definition of the latter, which centers around five key characteristics of play, is intentionally broad, offers a synthesis from several classic and contemporary definitions, and is widely acknowledged [68]. We relate each of Gray's characteristics of play to ST.

First, play is never enforced. It is 'self-chosen', meaning it is internally motivated, and 'self-directed', in that it implies agreement with the premises of the playful act [67,69]. Although ST is often initiated without awareness or intention [39], it is by definition generated by the individual, rather than imposed [70].

Second, play is conducted in an alert and active but relatively nonstressed state of mind. Analogously, ST, unlike dreaming, requires being awake and, unlike ruminative, obsessive, and goal-directed thoughts, must be free of impinging worries and stressors [4,13].

Third, play is imaginative, occupying a space between reality and inventions that, even when extremely original and creative, borrows elements from real-life scenarios [71]. Similarly, ST incorporates aspects of the real world while relying on internal knowledge and memories [28,29]. Supporting the idea that play and ST share the same modality of content generation, some of the brain areas underlying ST, including the DMN [6–8], are also active during spontaneous play [72,73].

Fourth, play is guided by rules, but these rules leave room for creativity. To whatever extent, play always has some structure. Yet, the structure needs not, and often does not, match that of reality. Similarly, ST is a structured process that draws from memories and knowledge while recombining existing concepts into new associations through analogies and reformulations [29,74].

Fifth, play is intrinsically motivated. Although play entails specific goals, players typically care about the process of pursuing the goal and not exclusively or necessarily about the act of achieving the outcome [55]. We propose that this final aspect of play, too, is mirrored in ST.

If in play a child may set out to make a love potion out of wood sticks, leaves, and mud, in ST, one might consider how to survive a plane crash by using a blanket as a parachute. While we are unlikely to accomplish the former and hopefully never need to attempt the latter, setting arbitrary, fictional goals initiates a stream of thoughts that generates novel ideas or connects established ones in new ways. As a result, similar to play, the value of ST might stem in large part from the thought processes it enables, rather than only from the points to which it leads.

Fictional goals in spontaneous thought

Most studies connecting ST and goals focus on personally relevant and real objectives. Indeed, the connection between ST and current goals or concerns is well established [38,75] and considered key to the cognitive benefits of ST [5]. However, ST is an extremely heterogeneous construct [76,77]. Although it also encompasses purely associative thinking [78], some ST involves thoughts about goals we only simulate to make predictions [19] and not necessarily plan to realize. Bizarre and unrealistic daydreaming (a type of ST) is not uncommon [75,79]. In any case, our argument is not about whether ST is concerned with reasonable or farfetched scenarios, but rather that it does not matter. Whenever imagined goals entail realistic scenarios, even when unlikely to take place at all, they help us prepare for the future as a valid replacement for experience [19,28,80]. As long as a goal provides enough structure, even unrealistic settings can be used to scaffold thoughts and direct the generation of hypotheses, plans, and creative ideas — some of which may eventually lead to worthwhile discoveries [36,37,33].

Most benefits of fictional goals apply to both play and ST thanks to their shared characteristics. Goal setting is cognitively taxing, as it entails allocating vast amounts of cognitive resources to support the ensuing goal pursuit [42,81]. Being detached from the pressure of everyday constraints, both play and ST afford the freedom to explore goals in a lightweight form, whereby only select aspects of real life need to be considered, often in an abstract form [19,71]. Moreover, both processes enable us to experience scenarios we could never encounter in the real world, which carries intrinsic value [82]. Compared with play, some aspects of ST make it uniquely suitable to serve as a platform for fictional goal generation and related thinking.

For instance, children's pretend play often compresses time to focus on salient moments [83], but ST allows us

to flexibly and quickly manipulate information across timescales [84] without the need to maintain consistency across episodes or wait for enacted scenes to unfold before continuing to the next. Moreover, play is most prevalent during the protected period of childhood [85], while ST extends throughout all stages of life (although its frequency tends to decrease with age [86]). Play is typically physical, external, and often public and social, whereas ST is always private, internal, and independent. As a result, ST can occur anytime and anywhere. Indeed, the fact that ST permeates all (including inappropriate) moments of wakeful activity partly explains why it is often viewed as disruptive [87]. Its inaccessibility enables ST to provide a unique platform for simulating and evaluating interesting scenarios while escaping judgment, social constraints, and full energy investment [88].

Discussion

For decades, ST has puzzled psychologists and been largely taken as wasteful and disruptive. Several useful functions of ST have gradually been identified, but the aspects of ST that significantly deviate from present goals and concerns are still hard to reconcile with existing accounts for the benefits of ST. Our proposal to look at ST as goal-oriented 'mental play' remedies this discrepancy.

Underestimating the importance of ST as a valuable thought process has consequences at both scientific and societal levels. As researchers, a more complete view of ST's roles may help further our understanding of its cognitive, behavioral, and neural correlates as well as their relationship with other functions. For instance, connecting ST and goal pursuit through play might alter our interpretation of existing work on the DMN, a network encompassing medial (prefrontal, parietal, and temporal) and lateral (parietal and temporal) cortical regions [89] and most prominently associated with ST [6–8]. While primarily studied in resting state modalities, the DMN is also implicated in goal-oriented processes [90,91]. We predict the DMN to play a similar role even when the goals in question are not actively being pursued. This account is consistent with a general view of the DMN as neural machinery for associative thinking [19,28,92], which is required by active simulation of goal pursuit in any context, fictional or not. Linking ST to play in a more substantial manner might also better position researchers tackling the neural mechanisms of the latter. Neuroimaging studies on play are currently lacking, but initial evidence suggests an involvement of the DMN [73]. While current proposals attribute such activation to social aspects of play [72], they may in fact be more broadly related to the simulation of fictional goals.

As a society, lacking an understanding of when and why ST should be prioritized [93] has resulted in ST being dismissed (and even punished), such that we often prefer filling our time with menial or damaging activities to giving space for thoughts to spontaneously arise [94,95], possibly resulting in severe consequences for our identity, creativity, and mental health [33,96]. In the real world, our values are frequently captured by existing incentives, often set by large institutions (e.g. grades and rankings) or quantified by simple devices and applications (likes and points) [97]. When it is not focused on existing concerns, ST has the potential to help us step back from socially imposed measures of success and create shelter for the evaluation of goals and the realities they enable — no matter how extreme or unrealistic. In ST, we can experiment with different value systems, which allows us to regain autonomy in our value definition and ultimately contributes to a fulfilling life [97].

Conclusion

We propose that one way to further our understanding of ST and its relationship to other cognitive processes is by drawing a high-level analogy between ST and play. While recognizing a link between the two comes with several interesting avenues for further research and discussion, we focused on the role of goals in both ST and play, arguing that, like play, ST is useful even when — if not exactly when — it entails unrealistic or frivolous goals. Similar to play, ST can serve as a platform to invent, unfold, and pursue fictional goals without needing to commit to them, thus supporting our abilities to plan and innovate. Undisturbed by external forces, ST also uniquely contributes to the reassessment of personal values, contributing to our sense of self and independence. Despite being troublesome when occurring at inappropriate times, play is now recognized as an important aspect of development, especially as the value of fictional goals in play is acknowledged. While play is prominent during childhood, ST, with its similar characteristics yet more internal and private nature, might be the adult version of constructive play. In light of its similar merits, ST deserves at least the same care, protection, and appreciation we devote to children's play.

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Author Contributions

Gaia Molinaro: Conceptualization, Writing – original draft, Writing – review & editing **Moshe Bar:** Conceptualization, Supervision, Writing – review & editing.

Data Availability

No data were used for the research described in the article.

Declaration of Competing Interest

Nothing declared.

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- •• of outstanding interest.

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