Play, Curiosity, and Cognition | Annual Review of Developmental Psychology by Junyi Chu and Laura E. Schulz

1. This willingness to incur unnecessary costs to achieve idiosyncratic ends allows humans to create a vast array of problems we would not otherwise have.
2. Three non-cognitive accounts of play include: (1) Play for pleasure (2) play as performance (i.e. play as a signal of fitness) (3) play for peacemaking
3. Play is a sensitive signal: it drops off quickly in response to real and perceived threats, recovers quickly in their absence, and flourishes in resource-rich environments.
4. Two cognitive accounts of play ---- (1) play for practice (2) play for predictions and plans
5. Infants selectively explore objects that appear to violate their naïve theories, and explore in ways specific to the apparent violation.
6. Learners set their own goals for learning, selectively attend to information that is learnable, and decide what and whom to learn from.
7. We believe novel problems and goals may be critical to human cognition because problems constrain search, …
8. … and narrowing the search space sufficiently to generate new hypotheses is arguably, far more than learning per se, the hard problem of cognition.
9. How do people, and how can machines, expand their hypothesis spaces…
10. … to generate wholly new ideas, plans, and solutions?
11. We propose that our recognition that a problem is tractable – …
12. … in the sense of containing enough information to guide the search for a solution –
13. … inspires the kind of curiosity which can sustain long-term engagement in the face of negligible information gain.
14. Humans can be fascinated by questions we will probably never answer…
15. … and by questions that may take years or even lifetimes to answer.
16. To the degree that we can continue to generate speculations, hypotheses, and partial plans, …
17. … we may feel like we are making progress on a problem even if there is no evidence to assess that progress.
18. The degree to which a problem or goal supports the generation of plans and hypotheses may itself be motivating – …
19. … whether or not the plans actually bring us closer to attaining the goals and whether or not those hypotheses reduce prediction error.
20. We propose that in humans, intrinsic reward is tied to the ability to act and think, …
21. … not merely the consequences of our actions and thoughts.
22. We believe children's often rapt absorption in solitary play suggests the intrinsic reward associated merely with thinking.
23. Actual solutions – ones that reduce uncertainty and increase prediction and control – can come only later, if at all.
24. Although this kind of distinctively human play may be useless for many ends, …
25. … we have argued that it may be useful for thinking; …
26. … even frivolous problems contain enough structure and information to allow us to start generating new thoughts and plans.

27. One of the striking and characteristic features of children at play is that they often spend much of the day playing…
28. … and then abandon their plans both without ever achieving their goals and without any apparent regret.
29. We suggest that what matters about the child's play is neither the unachievable goal nor the half-baked solution…
30. … but rather the fact that the goal contained just enough structure to generate new ideas.
31. Why explore new ways to explore?
32. Why not just explore in ways most likely to increase learning?
33. Arguably, the reason is that epistemic goals are not the only – or necessarily even the best – way to learn new things.
34. If we explored only to try to maximize expected information gain, …
35. … we would miss the chance to gain unexpected information.
36. Creating new problems with no obvious utility in themselves – playing – may be the best way to discover genuinely new things.
37. How do we distinguish ill-posed problems that insufficiently constrained search…
38. … from those that are rich in structure and therefore potentially tractable?
39. How do we represent our own progress in thinking such that it can be a source of intrinsic reward?
40. We may be most curious not to the degree that we anticipate being able to answer our questions…
41. … but to the degree that we realize we may never stop thinking about them.