



## **An Introduction to the Study of Curiosity**

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The serious scientific and scholarly study of curiosity has extended over of the history of psychology as a discipline for more than a hundred years, but for much of this time it has received only passing attention. Few researchers of note have made it their principal field of study: Berlyne who published in the 1950s and 1960s from work in Britain and Canada is the most notable of the few who concentrated upon it. Yet, one would expect from general observation that curiosity, understood in simple terms as a desire to know or learn, should have been a central concept in education. Should not understanding how curiosity works contribute significantly to the practical business of facilitating the processes of learning? The results of some research on curiosity and intrinsic motivation do now appear in some education text books, but it is there as a minor theme in general works on motivation and not very well developed, so one is entitled to ask why, to be a little curious about that! You might like to make some suggestions as to why it has not played as large a part in formal education as might have been expected, and you might see a clue in the word "formal".

Curiosity, and the related more general field of intrinsic motivation, has been recognized as playing a part in a wide range of human endeavour: it contributes fairly obviously to the development of science, and it has a role on the creative arts although creativity requires a more aggressive production element as well as curiosity which forms the front end, as it were, of the creative process in both the arts and the sciences. Understanding intrinsic motivation is an important element in management, in which the satisfaction that workers can gain from their work in itself is significant apart from the fact that they are paid to do it. The sense of wonder, which is at the heart of curiosity is central to also to religious or spiritual strivings and worship. So any understanding we can develop of curiosity and related concepts can be expected to have some very broad applications in other fields, including science, scholarship, the arts, management, spiritual exploration and worship, as well as education.

While I do not believe it is necessary to think of curiosity as a motive, and some psychologists avoid the use of such terms, curiosity is commonly regarded as the prime example of intrinsic motivation; but there are other motives or processes in which there is intrinsic satisfaction. Achievement motivation, defined by McClelland as competition with an internalized standard of excellence, contains elements of it. Some psychologists have also written of how people will strive for competence which need not involve excellence in any comparative sense: people can gain great satisfaction simply from being able to do a particular thing, regardless of whether they can do it very well or better than someone else. A young child learning to walk, or later running, or dancing or throwing a ball, or threading a needle or working a computer, will display this kind of satisfaction with their own competence, and they will express it sometimes joyfully, without waiting for others to reward them. Robert White at Harvard wrote a famous paper on this in 1959 at about the time I began to work on curiosity. He was one of those, with Richard Alpert and David McClelland, who guided my work and supervised the writing of my thesis on the theory and measurement of human curiosity. It is a field in which I have published a few papers over the years but which I have never been able to give the attention it deserved. I have returned to it in retirement.

By intrinsic motivation we mean a process of arousal and satisfaction in which the rewards come from carrying out an activity rather than from a result of the activity. We speak of the rewards being intrinsic to a task rather than the task being a means to an end which is rewarded or satisfying. By contrast, we might work hard at a task in order to eat. Such work, undertaken as a means to an end, is typically deficit motivated behaviour in which there is a reward as a consequence of effort to reach a goal where the deficit is reduced. Psychologists in a tradition which was very influential in the middle of the twentieth century used to talk of the reinforcement of such behaviour through the satisfaction of a need, like hunger, which is reduced by attaining a certain goal, like eating. The means leading to the desired end will be learned, so the classical theory went. But with intrinsically motivated behaviour the distinction between means and ends disappears. Some activities are undertaken because they are rewarding in themselves, not because they are a means to something else which is an extrinsic reward. In this way the study of intrinsic motivation posed quite a challenge to traditional learning theory. That may be one reason why it was often neglected. Other behaviorists would have avoided it because it seemed to make use of intervening variables like motives. It turned out also to be a subtle and difficult subject, which tended to slip away from you whenever you started to get a grip on it. It required a different approach in which some new fundamental questions were asked.

Let's go back a way, quite long way, to get an idea of some of the critical elements in curiosity. I have found that the history of the use of the word will sometimes provide interesting clues to a psychological concept which is wider than current usage of the word. So with curiosity, it has in the past referred not only to our most common meaning of a desire (need, wish, want etc.) or inclination to know or learn especially about novel or strange things, but also to the application of care or careful attention to any object in general or a learning task or to a craft. So something might have been described as "curiously wrought", meaning it was crafted with great care. In the same broader sense of careful attention, curiosity formerly had a sense of being defined as a scientific or artistic interest. The key word at the origin of this wider usage is the now obsolete English word "cure", meaning care. I say obsolete because it is no longer used in its general sense of "care" although it survives in the now seldom used phrase "the cure of souls", meaning the care of people. Hence we have the clerical title "curate". We have also retained the more general sense of "cure", quite distantly, in "accuracy". Chaucer gives us a beautiful example of the earlier sense of "cure" meaning care or careful attention where in the Prologue to the Canterbury Tales he describes what is fundamental to the motivation for academic work in his "Clerk of Oxenford":-

There you have in its purest form what we are trying to understand: *Of studie took he most cure and most hede .....And gladly wolde he learn and gladly teche*. Academics today are not too keen on the "lifel gold in cofre", and we would not wish it to be seen as a necessary ingredient of this way of life, nor I suppose would the ancient clerk. The point is, however, that while he might have sought payment, and was pleased to receive it, it was not the reason he undertook his work. He would gladly learn and gladly teach because it was intrinsically rewarding, but there was a problem in gaining the means to do so. Intrinsic motivation cannot function in the absence of other needs being met. That is illustrated in the history of science and the arts.

If I might jump ahead for a moment and throw in one of the most interesting empirical findings by Deci and others in the more recent study of curiosity, there are peculiar interactions between the effects of intrinsic and extrinsic rewards, so that if you pay people for what they were doing purely out of interest, they will be less likely to do it in future without being paid. In the current context of a shift away from traditional academic leadership towards a business model of management in universities, there are many related questions about the management of incentives for academic work which I am hoping to address later in my current research.

Where does this fundamental notion of careful attention being at the base of curiosity lead us? I cannot review now the many studies which have contributed over the past fifty years or the earlier ideas of William James, Freud, McDougall and others who thought in terms of instincts. Broadly there have been two approaches. One looked principally at the processes of physiological arousal and saw curiosity behaviour as a product of seeking an optimal level of arousal, so that when there is not enough stimulus input people will seek more stimulation to avoid a painful state of boredom, and when there is enough to disturb but not so much as will cause an avoidance response, people and animals will engage in investigative and other information seeking behaviour to restore the optimal level. You will see that this approach retains a tension reduction model and seems perversely to explain intrinsically motivated behaviour as a means to an end, albeit internal to the organism. While there is much of value in this approach taken by Berlyne and others, I have preferred a cognitive approach which I think offers more insights and useful predictions although it does not deny that such an understanding of the arousal mechanisms cannot also provide useful explanations of what we observe. The cognitive and physiological approaches are not necessarily exclusive of each other; nor were they exclusive in Berlyne's basically physiological approach where cognitive processes played an important part in what he called epistemic curiosity; while Spielberg has combined the two, especially in regard to the inhibiting affects of anxiety on curiosity.

My "cognitive process theory" has much in common with several others, but let me describe it my own terms. I see curiosity as a process of creating, maintaining and resolving conceptual conflicts. Such conflicts arise from a lack of fit between an incoming signal or stimulus and a cognitive map or category system which represents the world from past experience. It is built upon some very primitive unlearned responses, such as the orienting response which directs attention to new stimuli or to anything which stands out from the background in one's perception of the environment. People quickly learn to make sense of such signals as part of a more complex learned process of adaptation by referring them to an ordered representation of what has happened before. If it is something very similar to what is already there it will be easy to encode its meaning by fitting it into that representation of past experience, but if it does not fit easily there will be a conflict which can be resolved by one of two processes of modification, which following Piaget I called assimilation and accommodation. In the first, assimilation, the conceptual conflict is resolved by changing one's perception of what is out there, that is by modifying the signal to fit the cognitive map. Alternatively, one can modify the cognitive map to accommodate the signal. The more strange, unusual or unexpected the event, or you might say the greater the information value of the signal, the greater will be the need for assimilation or accommodation or both. People who readily assimilate what they experience to what is already known will not experience very much curiosity. That might be because they experience little conflict when they do not have a sufficiently differentiated map of the world for a novel event to cause much conflict, or because they are too anxious to perceive its unique characteristics and act defensively to put it away with as little trouble as possible. The highly curious person will have a high regard for the uniqueness of the signal and for the integrity of the cognitive map, and so will be loathe to either assimilate or accommodate. He or she will seek the best possible fit, and typically that will require seeking additional information to build a suitable new integration of the incoming information with what was known before. So questions will be asked, calculations might be made, things will be turned over and looked under, there may well be much wondering and doubting, but after the ball has been kept bouncing for a sufficient length of time some sort of resolution will be reached in which sufficient accommodation occurs for the conceptual conflict to be resolved. The result is that a new order of representation of the world is developed. The assumption we make is that there is a natural tendency towards such a systematic integration of the cognitive map that is given in the way the brain functions.

While curiosity is a *state* commonly experienced by all people, and there are some events which arouse curiosity in almost everyone, it is also a *trait* which is much more typical of some people than others. So a magician might by clever manipulation produce unexpected events which make most people curious. Where did that come from? How did he do it? Such wondering illustrates the state of curiosity. The trait which varies between people is seen in the way that some events will be seen by some people as strange or peculiar while others will pass them by with little interest. Some people are more likely than others to be in situations where strange or novel events occur and when they occur they will be more likely to become the focus of attention. Some might have gone out looking for them, or they might have been more sensitive to those small discrepancies which attract attention.

That sensitivity to small discrepancies against an ordered background is due to two contrasting facets of curiosity as a trait: openness to novel stimuli and a concern for orderliness. Now to an empirical finding, when those two personal qualities are measured separately from curiosity we find, as you would expect from common sense, that they are negatively correlated. That is, that is people who readily accept and seek out novel, strange or unusual things, who are in general stimulus seeking (to use Zuckerman's term), tend not to be overly concerned with having everything in its proper place or with orderliness in general, *vice versa*. But, although these two qualities tend to be opposed and not often found together in great strength, it turns out that highly curious people tend to have both these contrasting characteristics, they both seek novelty and value orderliness. You can see, in terms of the theory, that if they had either one alone, that is if they sought novelty without care for order, or they disregarded novel stimuli while guarding their well ordering map of the world, they would experience few conceptual conflicts; whereas if they tried to do both they would experience many conflicts, and some of them would be intense. The result then of combining openness to novelty and orderliness is a propensity for that careful attention we have called curiosity.

Some recent researchers, like Mary Ainley in the Psychology Department here at Melbourne, have distinguished between breadth and depth types of curiosity. What I have described above is close to her understanding of "depth curiosity", and she has found that one of my measures of curiosity correlates highly with her depth factor, while the breadth factor corresponds more to stimulus seeking in general.

To continue with the characteristics of highly curious people, I like to think of curiosity as belonging at the border between chaos and cosmos, so highly curious people will remain longer than others in situations of uncertainty, as well as being more likely to be there, that they will have developed a range of investigative skills to help resolve conceptual conflicts by gathering additional information, that they will have a sufficient sense of security in their world to put their cognitive map in jeopardy without debilitating anxiety, to run the risk of creating a new and better order, and that they will have the capacity to carry out the integration required to create a sense of cosmos where there was the threat of chaos. That is, they will be able, typically, and more than most people, to create, maintain, and resolve conceptual conflicts.

Now I think you can see that there are some practical implications of this understanding. For example, in the times of cultural revolution and the promotion of rapid social change, a few decades ago, there was a tendency in education to emphasize openness to novelty, and flexibility in general; but, while it has its value it will not result in intrinsically motivated learning without that regard for order which makes up the other half of the conditions which give rise to conceptual conflicts and the greater likelihood of investigative behaviour. Mere openness and its associated value of flexibility will not do the trick on its own. On the other side, the tendency to value established order in large institutions will militate against that openness which is also essential. Conceptual

orderliness and regard for social order are not the same thing, but they tend to be related culturally. For example, highly curious children have been found by Wallace Maw to be more socially responsible than those with little curiosity. But obviously too much concern for social order as with mere stimulus input will be counterproductive. Much more follows in various fields, and hopefully the practical consequences of an empirically supported and well developed understanding of curiosity will help to improve conditions of work and learning so as to make a number of professions more effective.

**The most relevant of my own papers are as follows:**

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