



Looking up at the curious personality: individual differences in curiosity and openness to experience

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The study of trait curiosity — individual differences in curious thoughts, feelings, and actions — sorts into two approaches. One looks *downward* by unpacking and differentiating trait curiosity, with an emphasis on curiosity's facets, kinds, and parts. Another looks *upward* by locating trait curiosity within the larger structure of global personality traits. This article reviews research that looks upward by locating curiosity within modern models of Openness to Experience. Our review indicates (1) that most — but not all — models of Openness to Experience explicitly include curiosity-related facets, and (2) that they tend to favor curiosity's academic and intellectual forms. In accordance with recent network-psychometric analyses, we propose that a broader sense of curiosity — captured by intellectual curiosity, intellectual interests, and variety seeking — emerges from a large pool of Openness to Experience inventories, and that these curiosity facets are central to the global trait. The literature that looks upward at curiosity would benefit from connecting to the diverse and expansive literature that looks downward at it, and network science models offer a fruitful strategy for building a hierarchical model of curiosity across these levels of abstraction.

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Current Opinion in Behavioral Sciences 2020, 35:1–6

This review comes from a themed issue on **Curiosity (Explore versus Exploit)**

Edited by **Daphna Shohamy** and **Ran Hassin**

<https://doi.org/10.1016/j.cobeha.2020.05.013>

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The notion of curiosity as a source of motivation, learning, and development extends deep into the history of psychology [1,2^{*}]. Like most aspects of human motivation, curiosity has been explored both as a state and as a trait. Research on state curiosity is wide ranging, from neuroscience to emotion to human development [3^{*}]. Research on trait curiosity, a complementary field, is just as broad.

It has explored individual differences in all aspects of curiosity, from diverse domains of knowledge to distinct underlying processes [4].

Research on trait curiosity has generally taken one of two paths. One approach looks *downward*: it seeks to unpack, articulate, and differentiate trait curiosity, with an emphasis on kinds, facets, and distinctions. Lines of research by Litman, Kashdan *et al.* are exemplars of this approach [5,6^{**},7,8^{**}] and good places to start for researchers interested in curiosity's lower-order structure. Another approach looks *upward*: it seeks to embed trait curiosity within the broader structure of human personality, with an emphasis on locating curiosity within the lower-order structure of complex, global between-person traits — the broad patterns of meaningful variation at the population level [9^{*}].

Both approaches illuminate the structure and substance of trait curiosity, but this article focuses on looking upward. Recent research in personality psychology has enriched and expanded our understanding of where trait curiosity falls within the network of higher-order traits. We will first review current models of Openness to Experience, the most salient global trait for curiosity research, and see how modern models of Openness to Experience locate and assess curiosity. Afterward, we describe recent work on trait curiosity using network psychometric models [10,11^{**}]. Among their other virtues, those models allow researchers to unpack and visually represent the conceptual structure of complex, hierarchical traits [12]. Network models thus offer a unique way of seeing how lower-order traits like curiosity link to related traits at different levels of abstraction.

Openness to experience and curious people

For curiosity researchers, Openness to Experience looms large as the most relevant global trait [4]. All major models of personality that emphasize a limited number of ostensibly universal traits — such as the Five Factor Model [13], Big Five Model [14^{*}], HEXACO [15^{*}], and Big Five Aspects Model [16] — include Openness to Experience in some form, albeit with different trait meanings and structures. Other researchers have focused solely on Openness to Experience and proposed models that articulate the trait's meaning, scope, and structure (e.g. Refs. [17–19]).

In Table 1, we summarize and compare the leading models of Openness to Experience. Although not

Table 1

Locating curiosity within models of openness to experience

Model	Level of components	Openness to experience components	Role of curiosity	Example items
Five Factor Model [13]	Lower-Level Facets	Action Aesthetics Depth Fantasy Ideas Values	Curiosity is captured most fully by the Ideas facet, which captures enjoying learning, preferring complex, abstract, and philosophical ideas, and having broad interests.	The exact Ideas facet items cannot be reprinted here, but they broadly concern having broad interests, enjoying mental challenges, and being intellectually curious.
Big Five Aspects Model [16]	Mid-Level Aspects	Openness Intellect	Curiosity is tacit in the BFAS and not directly captured by either aspect, but the Intellect aspect's emphasis on intellectual engagement is the closest.	Curiosity is reflected in Intellect items like 'I like to solve complex problems' and Openness items like 'I love to reflect on things.'
HEXACO Model [15*]	Lower-Level Facets	Aesthetic appreciation Creativity Inquisitiveness Unconventionality	The <i>Inquisitiveness</i> facet explicitly captures curiosity, which describes information seeking and a desire for variety.	The Inquisitiveness items emphasize learning new things, such as 'I enjoy looking at maps of different places.'
Big Five Model [14*]	Lower-Level Facets	Aesthetic sensitivity Creative imagination Intellectual curiosity	Curiosity is explicit in the <i>Intellectual curiosity</i> facet, which describes having broad interests and a desire to learn about academic and intellectual topics.	People high in Intellectual curiosity would describe themselves as someone who 'is curious about many different things' and not as someone who 'has little interest in abstract ideas.'
Woo <i>et al.</i> 's [19] Openness to Experience model	Mid-Level Aspects and Lower-Level Facets	Aspects: • Culture • Intellect Facets: • Aesthetics • Curiosity • Depth • Ingenuity • Intellectual efficiency • Tolerance	Curiosity is explicit in the <i>Curiosity</i> facet ('Inquisitive, perceptive, has a thirst or desire for knowledge, and is interested in why and how things happen')	People high in the Curiosity facet would endorse items like 'I love to do experiments and see the results' but not items like 'I would not describe myself as a curious person.'

comprehensive, this group contains the most prominent models that have created personality assessment instruments to make their conception of Openness to Experience concrete. Their senses of the trait — and how curiosity links to it, if at all — is thus made explicit via the items that operationalize the model's view. The table unpacks each model's parts (facets or aspects), identifies the parts most closely linked to curiosity, and describes the model's sense of curiosity via its items, when applicable.

Examining Table 1 reveals a few major distinctions and themes. First, the models vary in the levels of the trait hierarchy that they seek to specify. Three structural levels appear in this family of models: the highest level contains the global Openness to Experience trait (the *domain* or *trait* level); a second, middle level contains a small number of aspects of the global trait (the *aspect* level); and a third, lower level contains a larger number of specific facets (the *facet* level). Most

models concern themselves with the first and third levels: Openness to Experience and its facets. One concerns itself with the first and second levels (the trait and aspect levels; [16]), and another addresses all three levels [19].

Second, curiosity is an explicit part of some models but tacit in others. Most models explicitly include curiosity as a facet, such as *curiosity* [19], *inquisitiveness* (HEXACO; [15*]), or *intellectual curiosity* [14*]. In others, curiosity is implied. In the NEO, for example, the *ideas* facet captures intellectual curiosity along with having broad interests and entertaining unconventional ideas. In the BFAS Openness-Intellect model, neither the Openness nor the Intellect aspect explicitly captures curiosity. Notions related to curiosity appear in items for both aspects, but Intellect probably captures more curiosity-related content via its focus on enjoying erudite topics and expending mental effort.

And third, the sense of curiosity in most of these models has an intellectual bent. The items tend to focus on topics that are associated with high culture (e.g. philosophy), academic topics, and intellectual domains. The scales vary in their intellectual flavor, but the conception of curiosity within Openness to Experience scales is much narrower than the ideas found in the literature that articulates curiosity's different forms and facets, an idea we return to later.

Finding curiosity in the conceptual space of openness to experience

Because of the breadth of Openness to Experience, there have been many attempts to derive a consensus of what comprises its structure at the lower levels [17,20^{••}]. One approach to derive this structure has been to theoretically define facets based on Openness to Experience related scales [17]. Another approach has been to employ psychometric network models of multiple Openness to Experience questionnaires to allow a data-driven structure of facets to form [20^{••}]. Both approaches converge on similar structures and reveal that curiosity is at the core of the trait. Although we view both approaches as equally important, we focus on the latter because it has the potential to reveal how curiosity is currently assessed and connected to other facets of Openness to Experience.

Psychometric network models represent an alternative perspective on the formation of traits (e.g. Openness to Experience). Rather than Openness to Experience causing responses to items in a questionnaire, Openness to Experience arises from the causal relations between its components (e.g. items and facets; [21]). From this view, the relationship between items and Openness to Experience is mereological: items do not measure Openness to Experience but are part of it [22]. This same perspective holds for curiosity — that is, curiosity is part of the network of causally coupled components that we call Openness to Experience [23]. These network models depict this perspective with nodes (i.e. circles), which represent items (or facets), and edges (i.e. lines), which represent (partial) correlations between nodes.

Christensen *et al.* [20^{••}] analyzed the complete pool of items from four different questionnaires of Openness to Experience — NEO-PI 3 (48 items), BFAS (20 items), HEXACO-100 (16 items), and Woo *et al.*'s [19] Openness to Experience inventory (54 items) — that were completed by a moderately large sample ($n = 802$) using a psychometric network model. The items of these questionnaires formed emergent clusters that were identified using a network dimension-reduction method [24], which in turn comprised the network of Openness to Experience (Figure 1). Thus, an emergent hierarchy arose from the dependencies between the coupled components in the network.

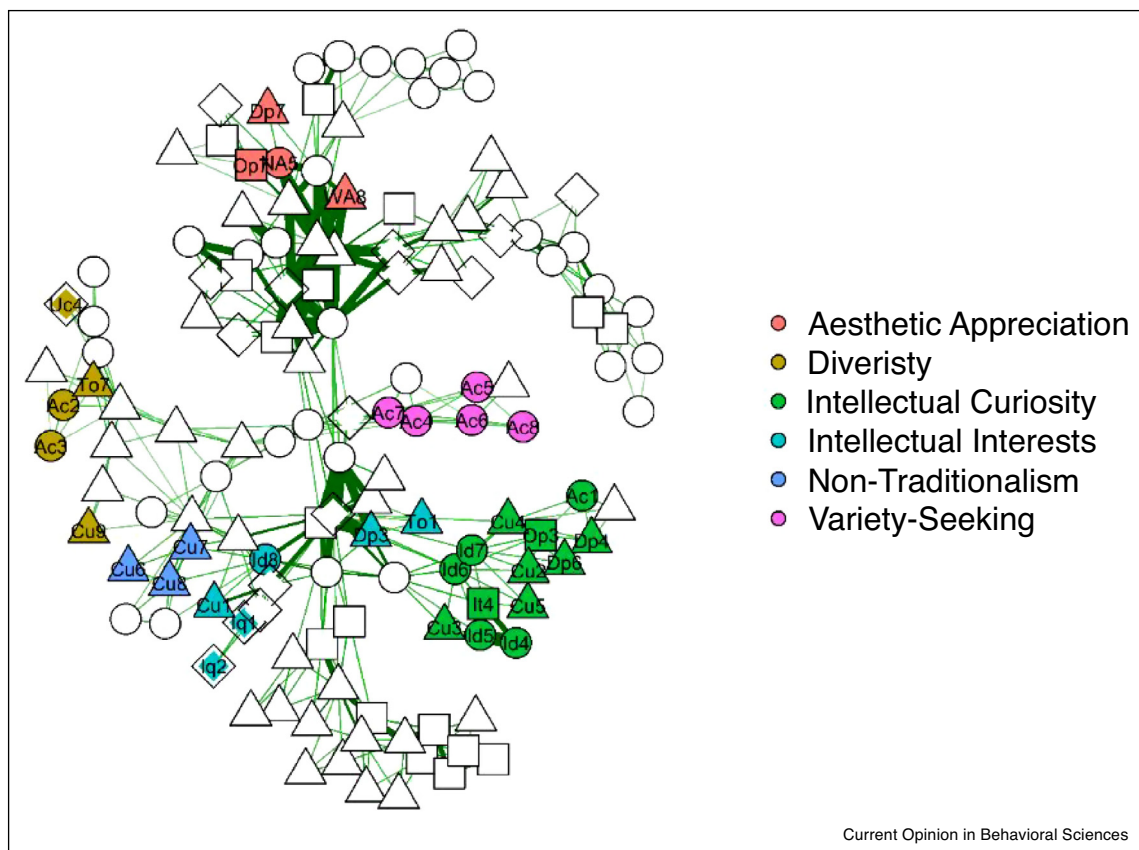
In this hierarchy, Openness to Experience was divided into three mid-level aspects based on their item and facet content: *Intellect* (akin to the Intellect aspect in the BFAS and Woo models), *Experiencing* (akin to the Openness and Culture aspects in the BFAS and Woo models), and the novel aspect of *Open-Mindedness*, a receptivity to unconventional or unfamiliar ideas, cultures, and lifestyles. These three aspects were in turn composed of 10 lower-level facets, which aligned with previous theoretical definitions [17]. The network model of all the Openness to Experience scales was thus more differentiated than the individual models, which have proposed at most 2 aspects and between 3 to 6 facets (see Table 1).

Of the 10 lower-order facets, we suggest that three primarily captured characteristics of curiosity: *Variety-Seeking* (being willing to explore new environments and new ways of doing things), *Intellectual Curiosity* (enjoying learning new things, thinking about complex problems, and reflecting on ideas), and *Intellectual Interests* (engaging with and discussing abstract, theoretical, and philosophical ideas). The item content of these facets centered around engaging with novelty — both in the environment and intellectually — as well as a general motivation to seek out new information. The facets of Intellectual Curiosity and Intellectual Interests were at the core of the network, as Figure 1 shows, suggesting that these facets are at the center of what's being captured across the family of inventories.

Items in these facets were connected to items of other core facets of Openness to Experience: *Non-Traditionalism* and *Aesthetic Appreciation* [17]. Non-Traditionalism was characterized by a receptiveness to new cultures and perspectives; Aesthetic Appreciation was characterized by engagement in the arts and perceptual experiences. Not surprisingly, there are components of these facets that correspond to curiosity, such as learning more about unfamiliar cultures and exploring the meaning of artwork (see Figure 1). Thus, although we suggest that three facets primarily captured characteristics of curiosity, we think there are others (e.g. non-traditionalism, aesthetic appreciation) that were simply not captured by the items in these inventories.

The network approach of all the scales thus yielded a richer and more detailed view of curiosity than any single scale could do. The intellectual flavor of most curiosity items split into distinct facets: one for a broader love of learning (intellectual curiosity), and one for academic and erudite domains (intellectual interests). And variety seeking — a core quality of curiosity in motivation theories [2[•]] — emerged as a distinct but underdeveloped facet. It was further clear that curiosity could be a part of other facets of Openness to Experience, indicating that flavors of curiosity may exist in different content domains.

Figure 1



Curiosity-related items in the network of four Openness to Experience inventories [20**]. Shapes represent each item's respective inventory: circles (NEO-PI 3), squares (BFAS), diamonds (HEXACO-100), and triangles [19]. Colors represent each item's respective Openness to Experience network-derived facet.

Looking up, down, and ahead

In this article, we 'looked upward' at trait curiosity to explore how popular models of global personality traits represent and assess individual differences in curiosity. A review of the leading models and assessment tools revealed that curiosity was included in all of them, although it ranged from an explicit facet assessed with a distinct subscale to a tacit concept assessed more diffusely. In addition, the models tend to define trait curiosity in a relatively intellectual, erudite way.

A network of Openness to Experience inventories demonstrated that items related to curiosity were widespread, covering six of the ten facets. Most of these items were in intellectually related facets (intellectual curiosity and intellectual interests), with the rest scattered between aesthetic (aesthetic appreciation) and cultural (non-traditionalism, diversity, and variety-seeking) facets. It is clear from the network that curiosity is a central component of Openness to Experience, which represents a core attribute of the trait.

When considering these findings in the broader context of 'looking up' and 'looking down,' it becomes apparent that curiosity is a complex, multifaceted trait. On the one hand, curiosity manifests in many different content domains, such as aesthetics, intellectualism, and culture. On the other hand, curiosity emerges from many different motivations, such as thrill-seeking, exploration, and sociability [6**]. It's likely that different motivations can lead to curiosity in different content domains, with some motivations being more common in some content domains than others (e.g. cultural content and sociability motivation). Meanwhile, some motivations, such as a drive to eliminate the unknown (deprivation sensitivity; [6**]), may be more general and apply to all domains (e.g. Ref. [25]).

We have suggested that the assessment of trait curiosity captured within individual models of Openness to Experience is relatively narrow, with an emphasis on intellectual, cultural, and academic interests. The downward view of trait curiosity, in contrast, has developed diverse views of curiosity's many forms and flavors, many with their own micro-facets (e.g. Ref. [8**]). A worthy goal for

future work is to fuse these literatures. The network method described here can, within a single model, define trait structures at different levels of the hierarchy, so it has promise for not only evaluating the micro-components of trait curiosity but seeing how they nest within the higher-order facets and aspects of Openness to Experience.

One virtue of building a bottom-up view of a trait using network analysis is that researchers can enrich and expand the meaning of a trait by including seemingly similar constructs. A network model will reveal where, if at all, another construct connects to the network. In the case of Openness to Experience, we can round out our sense of the broader trait by including and analyzing items from similar constructs that are not formally part of Openness to Experience scales. It would be illuminating, for example, to explore how concepts like needs for uniqueness and novelty [26,27] and values related to excitement, stimulation, and tradition [28,29] nest within the broader trait and connect to the specific curiosity-related facets. And once the nomological network of Openness to Experience has been greatly expanded, we hope that it will serve as a foundation for further theorizing about the trait's structure and motivate the development of new scales informed by the broad network.

Funding

None declared.

Conflict of interest statement

Nothing declared.

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Papers of particular interest, published within the period of review, have been highlighted as:

- of special interest
- of outstanding interest

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