



Expectancies as core features of mental disorders

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Purpose of review

Expectancies are core features of mental disorders, and change in expectations is therefore one of the core mechanisms of treatment in psychiatry. We aim to improve our understanding of expectancies by summarizing factors that contribute to their development, persistence, and modification. We pay particular attention to the issue of persistence of expectancies despite experiences that contradict them.

Recent findings

Based on recent research findings, we propose a new model for expectation persistence and expectation change. When expectations are established, effects are evident in neural and other biological systems, for example, via anticipatory reactions, different biological reactions to expected versus unexpected stimuli, etc. Psychological 'immunization' and 'assimilation', implicit self-confirming processes, and stability of biological processes help us to better understand why expectancies persist even in the presence of expectation violations.

Summary

Learning theory, attentional processes, social influences, and biological determinants contribute to the development, persistence, and modification of expectancies. Psychological interventions should focus on optimizing expectation violation to achieve optimal treatment outcome and to avoid treatment failures.

Keywords

attention, conditioning, expectation, placebo mechanism, psychological intervention, social learning

INTRODUCTION

Expectancies¹ are a core feature of mental disorders, and the disorders summarized in current classification systems are characterized by specific patterns of expectations (e.g., expecting negative events in the case of generalized anxiety disorder). However, expectations also determine how people react to disorders and are one of the most prominent predictors of treatment outcome. Accordingly, many psychological interventions aim to modify expectations, and the success of psychotherapy may depend on the effective violation of expectations that maintain the disorder. Thus, an improved understanding of basic mechanisms that contribute to the development and modification of expectations is critical for developing effective interventions. In this article, we will summarize recent psychological and psychobiological research findings on the development, persistence, and modification of expectations, and we will also discuss implications for the development of effective interventions.

THE CLINICAL RELEVANCE OF EXPECTANCIES

Depression and anxiety disorders provide examples how specific expectations are core characteristics of the particular disorder. Negative expectancies about social and environmental influences as well as about general future events are typical for patients suffering from depression [1[¶]]. In a recent reformulation of the cognitive model of

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Curr Opin Psychiatry 2015, 28:378–385

DOI:10.1097/YCO.0000000000000184

¹ In this manuscript, the terms 'expectation' and 'expectancy' are mostly used in an interchangeable way. However, expectation is more frequently used as a specific, verbalized construct, whereas 'expectancies' may be present without full awareness (i.e., implicit expectancies).

KEY POINTS

- Specific expectancies are core features of mental disorders, and they have a tendency to persist despite contradictory experiences.
- Psychological interventions must be tailored to optimize the modification of expectations.
- Biological, social, and learning psychology offer concepts to improve our understanding of why clinically relevant expectations persist.

depression, Beck and Haigh [2] outline the close interdependency of expectancies and emotions. In anxiety disorders, expectancies about a disastrous outcome when confronted with a phobic stimulus are major contributors to anticipatory anxiety [3^{••},4[•]]. Interestingly, autonomic responses during anticipatory anxiety match autonomic responses during actual exposure [4[•]]. Similar processes occur among individuals with obsessive–compulsive disorder (OCD) [5]. Moreover, patients with paranoid ideation also expect others to show threatening behavior. In addition, expectations are predictors of the course and outcome of disorders [6–8]. Beliefs about treatment success, course of the disorder, personal options for controlling a disease, etc. are crucial for predicting treatment outcome, medication adherence, and quality of life (e.g., [9^{••}]).

The role of expectations has been frequently investigated among individuals with chronic pain conditions, including conditions with medically vague explanations (e.g., whiplash syndrome [10,11]). The concept of ‘fear/avoidance’ has been developed to describe an expectation-associated behavior pattern that is mainly motivated by fear of potentially harmful body movements [12]. Measures of pain-related fear/avoidance predict whether back pain will develop into chronic pain [13]. Furthermore, the persistence of whiplash syndrome 6 months after a car accident was best predicted by patients’ expectations of remission a few days after the accident [11], a result which has been recently replicated [14[•]]. This close relation between patients’ expectations and the persistence of pain-like syndromes suggests the importance of developing psychological interventions that focus on the optimization and modification of expectations, both for physical and mental disorders [15]. Intervention programs that target the optimization of patients’ expectations have been developed for patients undergoing cardiovascular surgery [16], for patients suffering from myocardial infarction [17], and as a side-effect prevention measure for women receiving drug treatments after acute breast cancer interventions [18].

Expectations either provided via verbal instruction or acquired via conditioning are considered to be basic mechanisms for developing placebo effects; they can be amplified via observational learning and empathic doctor–patient interaction. An important question arising from recent research on placebo effects concerns how placebo responses can be best utilized to improve patient care. Several recent papers discuss strategies for increasing placebo effects, reducing the risk of nocebo effects, and personalizing treatment programs based on these mechanisms [19,20^{••},21].

The idea that patients’ expectancies are a core maintaining feature of mental disorders raises the question of whether existing psychological interventions are optimally designed to challenge disorder-specific expectation. Traditional psychoanalytic interventions aimed to provide ‘corrective emotional experiences’ (e.g., [22]), whereas an important goal of modern exposure therapies is to optimize ‘expectancy violation’ [23^{••}]. However, the experience of expectancy violation does not necessarily lead to the modification of expectations. For instance, patients with panic attacks have frequent experiences indicating that chest pain does not automatically lead to myocardial infarction. Nevertheless, these patients continue to maintain their anticipation of catastrophic events despite the experience of repeated expectation-violating events. There are similar examples of expectation violation that does not result in modified expectancies for people with OCD, paranoid ideation, depression, and other disorders. It is therefore important to investigate how best to develop treatments to overcome the persistence of disorder-specific expectations.

In the following, we will first provide a general model for understanding expectation development, expectation maintenance, expectation violation, and expectation modification. Next, we offer new insights into the psychological and neurobiological processes that contribute to the persistence and change of expectancies. Finally, we discuss implications for treatment planning.

EXPECTANCIES: HOW THEY DEVELOP, PERSIST, AND CHANGE – A GENERAL MODEL

Figure 1 offers a framework for understanding the development, maintenance, and modification of expectancies. Conditioning plays a crucial role, as people learn that specific situations and situational cues (denoted as ‘X’) precede specific consequences (denoted as ‘Y’). Somatic and psychological anticipatory reactions result when individuals are

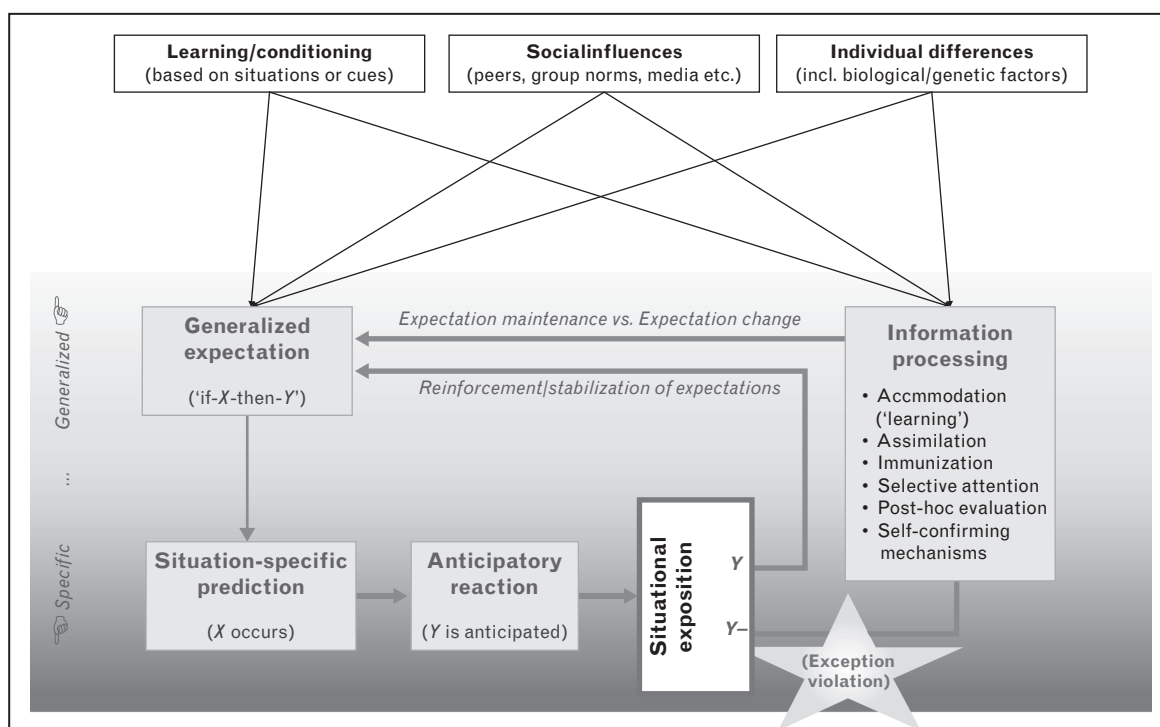


FIGURE 1. A model² for persistence and change of expectations.

repeatedly confronted with these situations or cues (this can also contribute to a self-fulfilling prophecy, e.g., in the case of individuals with social phobia who develop anticipatory anxiety in social situations and, as a result, behave in a way that increases the risk of negative evaluation). Social influences also contribute to the development of expectancies (e.g., observational learning, group norms). Prejudices and stereotypes about social groups are examples of highly persistent expectations. Electronic media and public information can also contribute to the development of medically relevant expectations. For instance, TV news broadcasts about the risk of drug side-effects increase the rate of reported side-effects substantially [24]. Finally, expectancies are associated with biological reactions (e.g., anticipatory brain reactions), and further research is needed to determine which central and peripheral biological systems are involved in the development and maintenance of expectancies.

Expectancies ('if-X-then-Y') can change if a person is exposed to a situation that violates expectations (Y is expected, but Y- occurs); in general, the larger the prediction error, the more likely expectancies will change. However, the reaction to an expectation violation situation can vary substantially across individuals and depends on person \times

situation interaction effects. Information processing in the exposure situation (e.g., attention processes), social processes, and memory techniques (post hoc evaluation) are examples of factors that determine the outcome of exposure to an expectation violation situation. We highlight recent research findings on these mechanisms below.

NEUROBIOLOGY OF EXPECTATIONS

From a neuroscientific perspective, effects and correlates of expectancies can be observed on most neural levels, that is, from neurons to complex neural systems. These effects have been found not only in humans and other mammals, but also in invertebrates [25]. In addition, most researchers agree that expectancy mechanisms are core features of nervous systems, that is, brains may actually be 'prediction machines' [26]. Out of this wealth of research, we will briefly discuss selected research areas and major findings.

Animal research (mostly with monkeys or rodents) has demonstrated that mesostriatal dopamine neurons show phasic activations to rewards and reward-predicting stimuli. These patterns seem to reflect prediction errors [27], which are crucial for changing expectations: unexpected but not expected events elicit dopaminergic activation (positive-prediction error), whereas omission of a predicted reward can decrease neural activity (negative-prediction error). Such findings have been

² The authors are grateful for contributions of Profs. Hanna Christiansen, Dominik Endres, Martin Piquart, and Ulrich Wagner to the development of this model.

replicated in humans [28,29] and extended to other brain areas such as amygdala activation during aversive coding [30,31[¶]]. The psychobiology of prediction error effects has been investigated in clinically oriented neuroscientific research in areas including pain, placebo effects, and anxiety [32,33,34^{¶¶}].

Moreover, many human studies, largely based on brain imaging and electroencephalographic/evoked response techniques, have shown that a number of additional brain areas are involved in expectancies. In the case of anticipation of pain and pain modulation by placebo, relevant brain areas include the orbital and anterior cingulate cortices, ventrolateral and dorsomedial prefrontal cortices, insula, ventral striatum, and periaqueductal gray matter [34^{¶¶},35–39]. Notably, these brain areas largely overlap with those found to be important in expectancy research in anxiety disorders (e.g. [40]). This research has demonstrated deficits in expectancy processing among individuals with anxiety disorders, including enhanced expectancies about threat probabilities and deficits in safety encoding [33].

Taken together, studies in this area indicate that a network of brain areas, including all levels of the brain (and, in the case of pain, even the spinal cord [34^{¶¶}]), seem to play a role in the neural processing of expectancies. Both bottom-up and top-down processes appear to be involved. The detection of stimulus valence and stimulus probability, allocation of attention, preparation of anticipatory reactions, and use of coping strategies contribute to the neurobiology of expectancy effects.

LEARNING AND CONDITIONING AS MAJOR MECHANISM IN THE DEVELOPMENT OF EXPECTANCIES

Although current learning theories differ in their assumptions about the nature of mental representations and underlying processes [41], these theories share the view that when a person experiences an unexpected event in a certain situation, such as nausea in a hospital after an initial chemotherapy session, s/he develops expectancies about this event. These learned expectancies, triggered by the same situation or a similar situation, guide behavior and result in an anticipatory, conditioned, or instrumental response (e.g., anticipatory nausea [42,43[¶]]). Expectancies acquired during conditioning procedures can also result in placebo effects (e.g., [44]), can explain stimulus control effects in addictive behavior [45], and play a major role in the persistence of anxiety disorders and avoidance behavior (e.g., [46,47]). Situations that include unexpected events and therefore violate

expectations should lead to the adjustment of expectations (e.g., accommodation; see Fig. 1). However, several factors are known to contribute to persistence ('immunization') rather than the adjustment of expectations (for a more extensive review see [48]). Examples of such factors include the accessibility of alternative expectancies for the unexpected events (such as features of positive and negative discrimination, protection of extinction by conditioned inhibitor [49[¶]], context effects such as occasion setting, renewal, and reinstatement [50^{¶¶},51[¶]]). The learning history of the events involved (conditioned stimulus-preexposure and unconditional stimulus-preexposure effects, learned predictiveness and irrelevance [52], and partial reinforcement extinction effects, e.g., [53]) further contributes to the persistence of expectancies.

THE INTERRELATION OF EXPECTANCIES, VISUAL ATTENTION, AND PERCEPTION

Expectancies and selective attention are closely related, and selective attention can play a crucial role in expectation maintenance and expectation change. This has been well studied for the visual system. However, the exact nature of this relationship is not yet fully understood. Summerfield and de Lange [54^{¶¶}] suggested that the visual system uses contextual information, such as temporal and spatial associations, to generate expectancies about upcoming sensory events. Several studies have demonstrated a so-called expectancy bias, that is, differential processing of expected versus unexpected perceptual information (e.g., [55,56]). Such an expectancy bias may result in a criterion shift for perception thresholds, which can be observed as an increase in neural activity before stimulus onset (e.g., [57]). In an early attempt to disentangle expectancy and attention, Summerfield and de Lange [54^{¶¶}] proposed that probability manipulations relate to expectancies, while task or action goal relevance relate to attention [58]. According to this theory, expectancies constrain visual interpretation based on prior experience rather than weighting visual input signals [59], and expectancies should be separable from top-down-induced attention effects. Indeed, there is evidence for this dissociation [60].

The notion of predictive coding (e.g., [61]) posits that predictions resulting from higher-order brain processes are compared with sensory evidence from lower brain processes, which accounts for many expectancy-related findings. Prediction errors resulting from this comparison of higher-order predictions and sensory evidence can be used for learning and updating of the internal model. Some recent

studies have provided evidence that attention may enhance the error signal to make unexpected information more salient than expected information [58] (see also [62,63]). Thus, attention may enhance the effects of expectation violations.

SOCIAL INFLUENCES ON THE FORMATION, GENERALIZATION, AND STABILIZATION OF EXPECTANCIES

As the model in Fig. 1 suggests, expectancies are not only 'directly' shaped by prior personal experiences, but also 'indirectly' by social influences – even in the absence of any prior personal experiences. For instance, observations of other people either benefiting from medical interventions or developing side-effects can shape the patient's subsequent treatment response [64,65]. Social psychological approaches offer further insights into the development and modification of expectancies, and research on stereotypes is particularly relevant to understanding generalized, often persistent expectancies. Expectations about social groups (e.g., ethnic stereotypes) are shaped by the influence of relatives, peers, partners, or the media – even if one has never met a member of that social group in person. The impact of stereotypical depictions in the media is particularly noteworthy in this regard. For instance, playing a violent video game in which Arabs (versus Russians) are displayed as terrorists, increases implicit and explicit negative attitudes about Arabs, a stereotypical representation of Arabs, and negative affect toward Arabs [66]. Thus, expectancies can be developed through relatively subtle influences. Social psychological research in this area would suggest that clinically relevant expectancies can be established via implicit associations provided through peers, group norms, or the media.

Generalized expectations (e.g., 'people from group X are dangerous') shape social behaviors and thus create social reality. Expectation-consistent behaviors, such as avoiding a stimulus out of fear, stabilize ('reinforce') fear of the stimulus [12,13]. However, approach-related behaviors can also stabilize a-priori expectancies: for instance, displaying hostility toward a person from a specific group (which may be rooted in the generalized expectation that 'people from group X are dangerous') can invoke counter hostility in the interaction partner – a stereotype-consistent behavior. In other words, a-priori expectancies can create a self-fulfilling prophecy via expectation-consistent behavior (e.g., [67]). In clinical contexts, this means that individuals who confront rather than avoid a feared situation may maintain negative expectancies about outcome, particularly if their expectancies

negatively impact their behavior (e.g., in the case of individuals with social phobia who show interaction patterns that provoke negative feedback from others).

As shown in Fig. 1, expectation violations (e.g., meeting a nice and helpful person from group X) do not necessarily change generalized expectancies. On the contrary, people invest considerable resources into defending their belief systems before they 'update' them [68²²]. Two specific defense strategies are 'data-oriented' and 'concept-oriented' immunization. Data-oriented immunization refers to cognitive reframing of the situation in which the expectation violation occurred. For instance, meeting a nice and helpful person from group X may be interpreted as 'this particular person is an exception to the rule'. This strategy is usually referred as subtyping [69]. By considering the exemplar as non-prototypical, the generalized expectation is not only maintained, but also reinforced. Concept-oriented immunization refers to reframing of the concept of which an event is diagnostic: when confronted with a friendly person from group X, people who harbor negative stereotypes against group X may attribute ulterior motives to the target ('He smiles, but deep inside he is malicious'). Clinical examples of this phenomenon are well known; for instance, people who survive a panic attack do not necessarily change their negative expectations about the consequences of their chest pain. Although the alternative expectation would be, 'my chest pain does not mean I will have a fatal myocardial infarction', some individuals maintain the negative expectation, believing that the last panic attack further damaged the heart, which will lead to a fatal myocardial infarction the next time.

In summary, we confirmed the importance of social influences on the formation, generalization, and stabilization of expectations (such as stereotypes); the expectation-stabilizing effects of expectation-consistent behaviors; and the difficulty in altering generalized expectancies by confronting people with expectation violations. These processes also apply to the persistence of clinically relevant expectancies.

EXPECTANCY VIOLATION AS A MAJOR GOAL OF PSYCHOTHERAPY

Changing patients' dysfunctional expectancies is a core element of modern psychotherapy. Relevant expectations may concern the probability of adverse outcomes (e.g., the overestimation of the probability of being infected with HIV among some individuals with OCD) or the valence of experiences (e.g., the unpleasantness of speaking in public

among individuals with social anxiety disorder). One method of producing change in expectations is cognitive restructuring, for instance, disputing the expected probability or valence of an aversive event. Exposure-based interventions challenge patients' expectancies more directly by creating situations in which patients can test and modify their expectations.

In a recent publication, Craske *et al.* [23²²] discuss the impact of an inhibitory learning model on exposure treatment and propose several novel exposure techniques that may lead to improved outcomes. The 'expectancy violation model' of exposure suggests that exposures should be designed to maximize the mismatch between expectancies and outcome to achieve optimal results.

In recent years novel developments have occurred in research on exposure-based treatments. A meta-analysis [70²¹] of 13 studies examining the use of D-cycloserine (DCS) in exposure treatment revealed that DCS effectively enhanced exposure therapy due to specific effects on extinction learning. Recent studies have also documented successful internet-based exposure treatments (e.g., for OCD [71], health anxiety [72], or PTSD [73]). Virtual reality provides another relatively new setting option for exposure treatment [74]. Diemer *et al.* [75] showed that virtual reality exposure elicited psychophysiological fear reactions among individuals with anxiety disorders and healthy controls, and might therefore be a promising treatment option for anxiety disorders. Exposure to movement with the goal of modifying harm expectations is a new treatment option with demonstrated efficacy for chronic back pain [76]. Acceptance and commitment therapy (ACT) [77²³] and metacognitive therapy (e.g., for OCD [78]) include novel exposure-based treatment elements that challenge patients' expectancies; strategies from these treatments might further improve the treatment of various mental disorders.

CONCLUSION

Expectations are core features of mental disorders. A crucial question in psychiatry is why expectations persist even when the individual is frequently confronted with situations that violate expectancies. Conditioning contributes to the development of expectancies, and stronger associations between anticipatory stimuli (X) and expected events (Y) produce more stable expectancies. Expectancies are associated with specific neural and biological processes (e.g., via anticipatory reactions and distinct biological responses after expected versus unexpected stimuli), and these processes can hinder

change in expectancies. Furthermore, behavior is selected that tends to confirm expectancies. Selective attention, psychological 'immunization' and 'assimilation,' and social influences can further stabilize expectancies despite contradictory experiences. Additional expectancy-stabilizing processes can operate via implicit self-confirming mechanisms based on subtle, unconscious influences. Psychological interventions should attempt to better address the persistence of expectancies despite experiences that violate expectations to improve the efficacy of therapies and reduce treatment failures.

Acknowledgements

None.

Financial support and sponsorship

None.

Conflicts of interest

There are no conflicts of interest.

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