RUNNING HEAD: VERBAL RULES IN CHRONIC PAIN

How an understanding of our ability to adhere to verbal rules can increase insight into (mal)adaptive functioning in chronic pain

Melanie Beeckman [a], MSc, Sean Hughes [a], PhD, Ama Kissi [a], MSc, Laura E. Simons [b], PhD, and Liesbet Goubert [a], PhD

[a] *Ghent University, Department of Experimental-Clinical and Health Psychology, Ghent University, Ghent, BELGIUM*

[b] *Stanford University School of Medicine, Department of Anesthesiology, Perioperative and Pain Medicine, Palo Alto, CA, USA*

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Corresponding author: Correspondence concerning this article should be addressed to Melanie Beeckman, MSc, Department of Experimental-Clinical and Health Psychology, Ghent University, Henri Dunantlaan 2, 9000 Ghent; E-mail: Mebeeckm.Beeckman@UGent.be.

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Abstract: Research on chronic pain has traditionally focused on how direct pain experiences lead to maladaptive thoughts, feelings, and actions which set the stage for, and maintain, pain-related disability. Yet the capacity for language (and more specifically verbal instructions or rules) to put people into indirect contact with pain has never been systematically investigated. In this paper we introduce a novel theoretical perspective on verbal processes and discuss how the study of verbal rules may increase our understanding of both maladaptive and adaptive functioning in chronic pain. Several useful characteristics of verbal rules and rule-following in the context of chronic pain are outlined. Future research directions and implications for clinical practice are then discussed.

Perspective: This focus article argues that by studying verbal rules and rule-following we will gain a better understanding of (mal)adaptive functioning in the context of chronic pain. Future research directions are outlined and suggestions for improving clinical practice are considered.

***Keywords*:** Chronic pain; indirect learning; verbal rules; rule-following; adaptive functioning; maladaptive functioning

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Chronic pain is a common health problem in adults [8] as well as in children [42]. Although many people seem to function well despite chronic pain, a considerable number experience restrictions in their daily functioning, from lower levels of physical activity, isolation from social activities, to increased absence from school or work [1,46,66,88]. Research has mainly focused on those risk factors that give rise to and exacerbate chronic pain-related disability, focusing on both intrapersonal, cognitive (e.g., catastrophic thoughts/worries about pain [19,82]), attentional (e.g., hypervigilance/selective attention to pain [18,83]), affective (e.g., fear of pain [78,88]), behavioral (e.g., pain avoidance [1,88]), and interpersonal factors (e.g., spousal solicitousness, parental overprotective behavior [28,60]).

Research in this area has typically focused on how *direct* contact with painful stimuli serves to establish, maintain, and exacerbate (maladaptive) pain-related behaviors, persistent pain, and pain-related disability [46]. Based on this work we now know that there are two important pathways via which pain-related behavior emerges when one comes into direct contact with pain. These are classical and operant conditioning [22,26,85]. Classical conditioning refers to changes in behavior that are due to the pairing of stimuli. For example, an individual may avoid a previously 'neutral' stimulus or activity, such as riding a bicycle, because it was repeatedly paired with actual pain experiences (e.g., low back pain occurred when cycling) [57,85]. Operant conditioning refers to changes in behavior that are due to the relationship between behavior and its consequences. For example, a teenage girl who suffers from recurrent headaches may try to avoid or escape activities that worsen her pain (e.g., dancing at a party) because doing so limits her pain experiences [22].

Although the aforementioned pathways have helped explain certain problematic pain behaviors (e.g., persistent avoidance), there are many other instances where such behaviors are not driven by direct pain experiences but rather what is learned via verbal information [89] or from observing others [30,38]. Take language for example. Verbal information can cause people to avoid or escape pain or related stimuli and events without the need for the person to actually encounter the events mentioned in that verbal information (e.g., "My mom said that if I go to that party I will likely experience back pain…I should just stay at home"). Clinical work suggests that many of the problems which individuals with chronic pain face are due to persistent attempts to avoid pain or its aversive consequences (e.g., injury, becoming handicapped or crippled) [22,46]. It comes as a surprise then that relatively little work has systematically examined the theoretical underpinnings of the impact of verbal information on chronic pain-related functioning [89].

This paper aims to rebalance the scales by outlining how indirect verbal processes can shape the behavior of those living with chronic pain. We open in Part I with a short overview of the current state-of-the-art. As we shall see, pain researchers have alluded to the idea that verbal information can establish, sustain, or change pain-related thoughts, feelings, and actions, even in the absence of direct pain experiences [4,48,56,70,89]. Nevertheless, this idea has never been systematically investigated nor has a theoretical approach been offered to explain how verbal processes influence the behavior of individuals with chronic pain. We fill this gap with Relational Frame Theory (RFT) [34], an account which has inspired many of the concepts used in Acceptance and Commitment Therapy (ACT), a therapeutic approach rapidly gaining popularity in the treatment of individuals with chronic pain [54]. Although ACT is known within the chronic pain literature, RFT has never been applied to the study of chronic pain-related functioning. Therefore in Part II we introduce RFT and discuss how verbal processes can bring people into indirect contact

with pain. Then in Part III we consider the role that one verbal process in particular (verbal rules and rule-following) may play in shaping how people function when living with chronic pain. Although we know much about the factors that increase one's risk of pain-related disability,[1,14,46,77,89], relatively less is known about those facilitating adaptive functioning. We argue that RFT is relevant in this respect as it speaks to both adaptive *and* maladaptive functioning. In Part IV we draw on insights from RFT to open up an entirely new line of research on the role of indirect learning via verbal processes in chronic pain. Finally, in Part V we consider the potential clinical implications of our new perspective.

Part I: Direct vs. Indirect Contact with Pain

As previously mentioned, chronic pain research has mainly focused on how and when *direct* pain experiences lead to (maladaptive) pain-related behaviors, persistent pain, and disability [46,87–89]. Consider, for instance, Fordyce's [22] operant learning account to chronic pain. His approach was the first to point out to the important role of patients' behavior in maintaining pain and disability. He specifically set out to explain when and why chronic pain patients demonstrate 'problematic pain behaviors' (e.g., excessive intake of pain medication, persistent avoidance of activities) and why those behaviors tend to persist across time. He argued that pain behaviors increase or decrease in frequency depending on their consequences. Specifically, if the 'benefits' of an action outweigh its 'costs' then those actions will increase in frequency. If the costs of an action outweigh its benefits it will decrease in frequency [22]. In the years that followed, cognitive-behavioral models, of which the Fear-Avoidance Model (FAM, [87–89]) is the most prominent, elaborated on this operant account while incorporating cognitive and affective components such as pain-related fear and catastrophizing. The FAM also views direct pain experiences as a starting point and argues that such experiences can lead people down one of two pathways. On the one hand, people can interpret

pain as non-threatening and this will subsequently elicit feelings of safety along with an increased probability of confronting the pain (thus improving their chances of recovery or adaptive functioning). On the other hand, people can interpret the pain experience as threatening which can elicit a sequence of catastrophic thoughts, pain-related fear, and avoidance behaviors, which raises the risk of impaired functioning. These models fed early cognitive-behavioral therapies for chronic pain and promoted the idea that changing one's maladaptive thoughts, feelings, and behaviors (e.g., via direct confrontation with feared or avoided activities or their consequences) was necessary for adaptive functioning [59].

The key point here is that empirical, theoretical, and clinical attention was often fixed on direct pain experiences and how they set the stage for pain-related thoughts, feelings and actions. Yet pain does not necessarily have to be directly experienced in order to influence what we think, feel, and do. Rather humans can come to catastrophize, fear, and avoid a wide variety of stimuli and events based on what they observe[30], tell themselves or are told by others [4,89]. This point has increasingly been recognized by chronic pain researchers who have started to integrate indirect contact with pain into their theories as well as therapies (e.g., ACT [54]). Although the pain literature has alluded to the importance of indirect, verbally-mediated learning pathways, it has yet to clearly specify how, and in what ways verbal processes or language in general is involved in driving pain-related thoughts, feelings, and actions. This is surprising given the prominent role language plays in everyday life.

Psychological theories and therapies are also converging on the idea that language is a double-edged sword. On the one hand, it is a fast, flexible, and efficient learning pathway that enables us to rapidly change our behavior without the need to laboriously learn via actual experiences [79,80]. For instance, a child can learn to avoid a painful experience they have never even

experienced via instructions (e.g., "You should avoid playing with fire, or else you will burn yourself and experience intense pain"). In other words, learning via instructions can be incredibly adaptive: the child in the above example learns to avoid intense pain without the need to actually experience that pain for themselves. On the other hand, people who rigidly rely on verbal information often become 'stuck' adhering to that information. Research suggests that rigidly relying on verbal information may play a central role in several types of psychopathology and may underpin impaired functioning in people with chronic pain as well [17]. Indeed, when people persist in doing things based on beliefs about 'the right thing to do' or 'how it should be', this often has unwanted consequences (see literature on e.g., substance abuse [50], self-harm [11], delusions [58] or depression [3,52]). We will return to this point in Part III. For now, we first require a theoretical model that offers a useful conceptualization of verbal processes, explains how those processes put people into indirect contact with pain, and explains how those processes set the stage for the types of problems common to those suffering from chronic pain. Relational Frame Theory can help in this regard [34,79]. Although RFT is a theory of human behavior that extends far beyond chronic pain, it can provide a useful approach to the study of verbal processes in chronic pain-related behavior.

Part II: Relational Frame Theory

RFT is a theory of human language and cognition. It is concerned with a type of human behavior known as Arbitrarily Applicable Relational Responding (AARR). This behavior has three defining aspects. First, it involves responding to one stimulus based on how it is related to another stimulus (cfr. the term *relational responding*) (e.g., not carrying a handbag because " it is *equally heavy as* wearing a backpack " or not running while in pain because "it is *more painful than* walking while in pain"). Although we can respond to one stimulus based on its physical relationship to another (e.g., we can avoid lifting objects that are similar in terms of their weight or size) people

also have the ability to relate stimuli in an *arbitrarily applicable* manner (i.e., in ways that do not depend on their physical relationship) (e.g., doing the dishes while in pain *is as painful as* changing the bed linens while in pain). Second, it turns out that when people learn to relate stimuli in one way, based on their own experiences or via verbal information given by others (e.g., "doing the dishes while in pain [A] *is as painful as* changing the bed linens while in pain [B]; changing the bed linens while in pain [B] *is more painful than* cleaning the floor while in pain [C]"), they can also *derive* entirely new relationships between those same stimuli (here: household chores) in ways that were never explicitly experienced or instructed, and which do not depend on their physical overlap (e.g., "doing the dishes while in pain (A) *is more painful than* cleaning the floor while in pain [C]"). RFT argues that it is this ability to derive relations between stimuli in an arbitrarily applicable manner that underpins human language.

The ability to AARR is quite simply a game changer: it unlocks incredible flexibility in the speed and ways that people can learn. Relative to other animals, humans can arbitrarily relate stimuli in a near infinite number of ways (e.g., "activity A *is different* from activity B" [distinction], "activity B is *the opposite* from activity C" [opposition]; for a review see [39]). AARR becomes clinically relevant when we add its third characteristic. Specifically, once a relationship between stimuli has been established, the properties of one stimulus and impact it has on our thoughts, feelings, and actions can be transferred to other stimuli. This is an abstract idea so let's consider a concrete example. Imagine a teenage boy who underwent a knee surgery. In the hospital his surgeon tells him that he is not allowed to engage in any sports for three months after the surgery because this leads to pain and impedes his recovery process. The boy informs the surgeon that he already feels a lot of pain while walking and that he is afraid of doing so. The surgeon then tells him: "walking (A) will be *less painful than* cycling (B)" and "cycling (B) will *be less painful than* wall-

climbing (C)". Consequently, the boy avoids both cycling and wall-climbing because he has equated one event (walking) to other events (cycling or wall-climbing), and when this happens, the properties of the former (i.e. painful activity) can transfer to the latter, as a result, leading to an increased avoidance of the other sports. That is, he avoids the other sports even though there are no physical resemblances between them (i.e., they are related in an arbitrarily applicable manner), and even though he has never encountered pain while engaging in these sports before. Put simply, a verbal relationship between stimuli ("cycling *is more painful than* walking") led to the transfer of negative thoughts, feelings associated with walking (e.g., being afraid of increased pain or hindrance of the recovery process) and subsequent attempts to avoid these other sports. This example illustrates that humans are not only able to learn *directly* from their actual experiences (e.g., the pain that was experienced while walking) but also *indirectly* via a verbally-mediated pathway that enables them to connect and respond to stimuli in entirely novel ways (e.g., avoiding cycling or wall-climbing based on an expected increase in pain).

If we combine the idea that stimuli can be related in many different ways, and that many different properties can be transformed through those relations, then complex forms of AARR can emerge. Take the previous example. Imagine that the boy fears and avoids cycling because his surgeon informed him about the potential danger of doing so (e.g., "If you ride your bike in the first three months after the surgery you will be in a lot of pain and it will hinder the recovery of your knee"). This example represents an instance in which the connection between the words ("a lot of pain") in the advice and actual stimuli in the world ("cycling"), as well as the causal relationship between the two, alter the properties of doing that sport (i.e., it has now become a pain-worsening activity because of its relationship with "more pain" established by the statement). According to RFT, these complex forms of AARR are what people refer to when they refer to the

fact that one's thoughts, feelings, and actions are governed by instructions or rules [40,79]. In other words, verbal instructions are conceptualized as stimuli (e.g. "If I want to avoid increasing my pain, then I should avoid lifting heavy objects") whereas adherence (or responding) to these instructions is viewed as *rule-following* (e.g., not lifting heavy objects [avoidance]).

Despite the powerful influence that verbal rules and instructions can have over our thoughts, feelings, and actions, their role in how people function in the presence of chronic pain has yet to be examined. In the following section we draw upon the ideas outlined above and showcase how verbal rules may shape the thoughts, feelings, and actions of people living with chronic pain, both in adaptive and maladaptive ways.

Part III: The Relationship between Verbal Rule-Following and (Mal)adaptive Functioning in Chronic Pain

In Part II we argued that RFT provides one way of conceptualizing verbal processes and in particular, verbal rules and instructions. We will now expand on these ideas and consider various characteristics of verbal rules and rule-following that may contribute to adaptive and maladaptive outcomes in chronic pain. Several of these ideas have already been studied within the pain literature, many are novel, and form the basis of an empirical program that is outlined in Part IV.

3.1. Rule following is a double-edged sword. Rule-following can be highly adaptive: it can prevent us from experiencing the undesirable consequences of certain actions without the need to actually experiencing those consequences for ourselves [80]. Consider our prior example of the boy who had a knee surgery and received advice from his surgeon to avoid playing sports in the three months post-surgery. In the initial days and weeks, adhering to his doctor's advice allowed him to avoid the painful consequences of playing sports and the potential negative impact it had on his recovery. He might even recover faster than another patient who underwent a similar surgery but

who had to learn via 'trial-and-error' that re-engaging in sports too soon aggravated their pain and delayed their recovery. Yet blindly following instructions can also be maladaptive [13,35,53,90]. For instance, imagine that after a few months the boy receives advice from his surgeon to re-engage in physical activities even though doing so might still hurt. Yet his mother continues to tell him to avoid those sports as much as possible. Now imagine that during the past three months the boy fully recovered from his injury but still experiences some pain. At this point, he can either follow the surgeon's advice or his mother's instruction. If he persistently follows his mother's advice ("Avoid cycling and wall-climbing. You are still recovering. These sports will lead to re-injury or heightened pain") then fear of pain or re-injury, and avoidance of activities will likely occur, even though this rule is no longer accurate (i.e., physical activity is no longer harmful). We know from the pain literature that persistent attempts to avoid pain can contribute to a range of negative outcomes on the long-run [46]. In sum, (pain-related) rule-following can have both adaptive and maladaptive consequences.

3.2. Rule-following is context-dependent. People construct and follow a (large) network of verbal rules, and throughout their daily lives they continually add to this network, augmenting its size and complexity [80] . Given such a network it is not possible to follow every rule all the time or in every situation. Thus rules have to be selectively deployed and the extent to which this happens likely depends on the context the person finds themselves in. Pain researchers are increasingly recognizing that the context plays an important role in the expression of pain-related thoughts, feelings, and actions. Likewise, pain-related responses are increasingly seen as dynamic styles that vary across time and context rather than stable habits (see [14,86]). Nevertheless, research examining the contextual factors that moderate pain-related responding (and rule-following) is still very much in its infancy (e.g., see research on goal-pursuit [12,14,21]).

We believe that many factors will determine if a pain-related rule is elicited in a given context and still other factors that determine if it is followed. To illustrate, imagine that a man with chronic low back pain is usually responsible for cleaning the house. However, because of his chronic pain condition, the man asks his wife to clean instead and generates a verbal rule such as "If I let her clean the house, I can rest and my pain will not increase". In this example there may be antecedents that influence if this type of rule is 'triggered' as well as consequences that determine if it is followed in that context. For instance, the above rule may be elicited whenever the husband sees that the house is dirty and needs to be cleaned (antecedent), whereas in other situations entirely different pain avoidance rules may be elicited (e.g., "If I take pain medication, I can go to work"). Thus, different rules are triggered in different contexts.

If the husband is at home and follows the 'avoid cleaning' rule mentioned above, then his pain level will not increase and the house may still be cleaned. These appetitive consequences will likely increase the chances that he will follow that same rule whenever the house needs to be cleaned in the future (i.e., he will rest and let his wife do the cleaning). However, if he follows the rule to rest but his wife does not clean the house, because she is stressed due to the extra household chores she has to carry out, he is likely to abandon the rule and resume cleaning. Thus, aversive consequences can decrease the chances that he will follow that rule in this context in the future.

The key point here is that different aspects of the context (antecedents) will determine whether a rule is elicited or not while other factors (consequences) will determine whether it is followed or not. In the above example we only mentioned a few of these factors and there are likely many more. For instance, the time (evening vs. morning) and place (home vs. work) where the rule is encountered or applicable, the source of the instruction (e.g., self or others), and the content of the rule (is it personally relevant, believable, and plausible) could all matter [36,43,80] . Likewise,

alternative rules could also be elicited in the same situation and these could also influence whether a rule is followed or not. In our previous example it might be that the man has one rule he generally follows (i.e., avoid cleaning) and yet an additional rule such as "If I want to be a good husband I should help with the chores" is elicited at the same time. Which of these two rules will guide behavior could depend on other goals and values present at that same moment in time. If the man values his role as a husband more than keeping his pain at a minimum level then the second rule will probably exert greater control over his behavior than the first and subsequently cause him to engage in painful activities (i.e., doing the chores).

To summarize, we argue that people with chronic pain likely have a large network of pain-related rules that they draw on when navigating their daily lives, and certain contextual factors (antecedents) will determine which of these rules is elicited at a given time or place. Yet just because a verbal rule is elicited does not guarantee that it will be followed. Rather other contextual factors (consequences) will determine to what extent the person behaves in line with the rule or not. Thus if we want to better understand the relationship between verbal rules and chronic pain we must focus not only on the content or type of rule (e.g., avoidance vs. activity engagement while in pain) but also on the contextual factors that determine when a rule is triggered and followed.

3.3. Rules can vary from specific to general. Earlier we outlined the idea that humans are capable of connecting stimuli to one another in a wide variety of ways, and that when this happens, the properties of one stimulus can transfer to others [34,40]. One implication of this ability is that a rule may be exclusively applied to a specific stimulus or come to influence how people respond to a whole range of other stimuli. In other words, rules can vary along a continuum from specific (e.g., "I should avoid cycling if I want to avoid pain") to general ("I should avoid all physical activity if I want to avoid pain"). Rules can differ in the number of stimuli involved (e.g., dishes

vs. all household chores), the range of thoughts, feelings, and actions that are impacted by the rule (e.g., worrying about the pain, or worrying about pain *and* not doing the activities), and the range of contexts in which the rule applies (e.g., doing the dishes at home vs. doing the dishes in general) [36,43,80].

'General rules' are useful in that they allow people to adapt to a wide variety of outcomes without the need to actually experience each and every one of those outcomes for themselves (e.g., "all physical activities will be painful"). Yet, as we previously mentioned, blindly following such rules can be maladaptive. To illustrate, consider a middle-aged woman with chronic low back pain whose pain systematically worsens each time she does the dishes, to the point that she eventually decides to quit doing them. She might be deploying a specific (pain-avoidance) rule such as "If I want to avoid worsening of my pain, then I should quit doing the dishes," which may result in the avoidance of this specific action (i.e., doing the dishes). Yet she could have also deployed a more general rule such as "If I want to avoid worsening of my pain, then I should quit doing household chores altogether." Because of its generality, this rule could cause her to avoid not only the dishes but all household chores (e.g., vacuuming, doing laundry, cooking) even though she never experienced increased pain while doing such chores before. It is highly probable that following this general rule will have a larger impact on her daily functioning than the specific rule. Thus we believe that the generality of a rule has the capacity to influence how chronic pain sufferers act in a wide range of situations, all in the absence of prior experience of pain in those situations.

The capacity for rules to be more or less general may help explain a number of phenomena observed in those with chronic pain. Consider recent work on the extinction of fear and avoidance of pain-related stimuli (e.g., [7,25–27]) which shows that although fear and avoidance of a single activity can diminish following exposure to that activity, this reduction does not necessarily transfer

to other avoided activities [7,25,27]. One possibility is that extinction is less likely when people follow general (instead of specific) verbal rules. For instance, imagine that the woman in our previous example actually engaged in one of the other household chores (e.g., doing the laundry), and as a result, she experiences that it is less painful than she expected it would be. This could cause her to generate a new 'exception' rule (see also [6,26]) that refers to this specific activity (e.g., "If I do the laundry, then my pain level will not worsen") and if she adheres to this rule and indeed experiences that her pain decreases, it is more likely that she will quit avoiding the laundry. Of course this is a simplified example and there might be many more factors which moderate following this rule. Yet, if we assume she follows this exception rule, this will not influence her level of fear and avoidance towards all other household chores because a general avoidance rule is still applied and still holds for the chores that are not mentioned in the rule.

To summarize, verbal rules can differ in how general or specific they are (i.e., how many stimuli, responses, and contexts are involved). In the context of chronic pain, the concept of general rules which refer to multiple stimuli could help explain how, when, and why avoidance (and related fear and catastrophizing) rapidly transfer from existing to novel stimuli. Moreover, once formed, general rules could influence a wide range of stimuli, responses, and contexts, making them difficult to extinguish. This could contribute to either adaptive or maladaptive functioning. We will return to this issue in section 3.6.

3.4. Rule-following has short -and long-term consequences. Following pain-related rules can have both short- and long-term consequences [80]. To illustrate, imagine that a young mother with chronic pain is planning a trip with her family. She values spending time with her partner and children, and yet by doing so she expects she will have to engage in many pain-worsening activities (e.g., walk all day, carry a heavy backpack, play with her children). If she were to follow a pain-

avoidance rule such as "If I avoid the trip, then I will avoid more pain" this may have certain appetitive short-term consequences (i.e., she avoids immediate contact with heightened pain). Yet if she persistently follows such a rule every time her family wants to plan a trip then this will likely have aversive long-term consequences (i.e., it reduces the extent to which she engages in valued activities such as spending time with her family). In contrast, imagine that she decides to follow a pain-acceptance rule, such as "If I accept that the pain will worsen, then I can go on the trip." In this case we can argue that although going on holidays with her family leads to aversive consequences in the short-term (increased pain) it also has short-term appetitive consequences (spending quality time with her loved ones). This pain-acceptance rule can also have appetitive or aversive long-term consequences. For instance, following such a rule may allow her to engage in *all* family activities while continually accepting the pain. Yet evidence from the pain literature also suggests that such excessive engagement in activities while in pain undermines people's ability to recognize when unnecessary pain can be avoided and may also lead to long-term aversive health outcomes, such as muscular overuse or hyperactivity, decreased well-being, and the development of disability [14,33].The point we want to make here is that there are no inherent good or bad (pain-related) rules (see section 3.1). Rather the *consequences* of following a rule make it adaptive or maladaptive for the individual, and one needs to consider both the short -and long-term consequences of rule-following, because what is good now can cause problems later or vice-versa.

3.5. Rule-following can increase our insensitivity to other ways of acting and their consequences. The short-term reinforcing consequences that are initially experienced when following a pain-related rule may cause people to rigidly deploy that rule over and over again (e.g., if following the rule reduces pain-related fear, catastrophic thoughts, or actual pain, a person with chronic pain may persistently follow that rule whenever possible)[52,80]. However, these immediate

reinforcing consequences can be problematic insofar as these decrease the probability that they search for alternative, potentially better, ways of responding that may have more beneficial outcomes in the long run (e.g., engaging in fun or valued activities despite the presence of pain). They might also reduce the chances that people come into contact with experiences that could correct their (incorrect) pain-related beliefs (e.g., "because of my chronic pain, I cannot perform any physical activity because this will harm my body"). This tendency to persistently follow a rule or instruction when it no longer applies, or comes at a cost, is known as "rule-based insensitivity" [44]. We believe that this phenomenon may help explain a commonly observed yet paradoxical behavior in individuals with chronic pain: the fact that they persist in avoiding certain pain-related activities even when doing so leads to aversive consequences (e.g., disability, depressive mood or fewer social contacts) [14,26,89].

Research outside of the pain literature suggests that once behavior falls under the control of a verbal rule, people often become insensitive to either (a) the long-term consequences of their actions or (b) other contingencies in the environment [3,52,58,65]. It is important to realize that just as a certain type of rule is neither adaptive or maladaptive (see section 3.1) so too is rule-based insensitivity neither adaptive or maladaptive. In certain situations it may be adaptive to be insensitive to other ways of behaving (and its consequences) and simply persist in following a rule (e.g., accepting some pain while doing physical exercises in order to facilitate the recovery process after an injury [80]). Nevertheless, in other cases, rule-based insensitivity can be maladaptive because it undermines people's ability to adapt to the specific situation or change their behavior according to what the situation demands. For instance, in the context of chronic pain, being insensitive to the negative long-term consequences of persistent adherence to pain-related rules might prevent people from seeking alternative ways of dealing with such pain. In short, the consequences of rule-

following can make people insensitive to other ways of acting or the long-term consequences of their actions.

3.6. Rule-following and (mal)adaptive functioning in chronic pain Until now, cognitive-behavioral accounts of chronic pain-related problems (such as the FAM) have mainly focused on the specific content of a person's thoughts and how this relates to their functioning. They have identified several classes of thoughts (e.g., catastrophic thoughts), feelings (e.g., fear) and actions (e.g., avoidance behavior) that increase the chances of long-term adverse outcomes and have labeled these as 'maladaptive' [1,88]. We take a different perspective. Instead of exclusively focusing on the content of rules, we argue that it is more useful to focus on the origins (i.e., AARR), characteristics, and the adaptive or maladaptive effects of rules and rule-following (see section 3.1 – 3.5). Doing so opens up an entirely new perspective on chronic pain-related functioning. To illustrate, consider a common idea in the chronic pain literature: that persistent attempts to avoid chronic pain are inherently problematic or maladaptive (e.g., avoiding painful stimuli). Specifically, according to this perspective, such attempts are maladaptive because they can contribute to the development of long-term disability and other maladaptive outcomes whenever pain is chronic (e.g., social isolation, depression, disuse [46,88]). In contrast to others, we argue that rules and rule-following (and behavior more generally) cannot be defined as inherently 'good' or 'bad' based solely on their content (e.g., whether they involve fear or avoidance). Rather understanding if adhering to a specific rule leads to adaptive or maladaptive functioning requires that we first take into account: (a) the specific short- and long-term consequences of following that rule in different contexts (see section 3.4), and (b) how persistently that rule is being followed irrespective of its consequences in those different contexts (see section 3.5). We would argue that one's *inflexible* adherence to pain-related rules despite its negative consequences may be a

characteristic marker of individuals who are at risk for developing disability and decreased well-being. Conversely, the ability to *flexibly* switch between pain-related rules based on the consequences of rule-following may be key to adaptive functioning and say more about adaptive functioning in individuals with chronic pain than the actual content of their thoughts, feelings, and actions [80]. For example, learning to evaluate the short- and long-term consequences of following a pain-avoidance rule (e.g., "I should avoid going to that party to avoid pain") versus a pain-acceptance rule (e.g., "I should accept some pain in order to see my friends at that party") within a given context, and having the ability to flexibly switch between rules depending on those consequences, may be necessary to live a valued life in the presence of chronic pain.

Interestingly, the idea that certain individuals with chronic pain manage to find and keep a balance between engaging in valued activities and avoiding pain-worsening activities across time and context has become increasingly popular. This practice is correlated with living a fulfilling life in the presence of chronic pain and is the central focus within Acceptance and Commitment Therapy [29,41]. These individuals are often described as showing high levels of 'psychological flexibility' (i.e., the ability to persist or change behavior, depending on the context, in the pursuit of goals or personal values, and being able to fully contact the present moment and the inner thoughts and feelings without needless defense [35,53,81]). The idea of flexible rule-following discussed above might be related to the idea of psychological flexibility. We will return to this idea in section 4.4.

Summary. In this section we examined several characteristics of rules (e.g., specificity, context-dependency) and rule-following (e.g., short- vs. long-term consequences, [in]sensitivity, [in]flexibility). We argue that these novel ideas have the potential to increase our understanding of

(a) the role of verbal processes, and (b) (mal)adaptive functioning in the presence of chronic pain. In what follows we consider ways that future research could systematically examine these ideas.

Part IV: Future Research Directions

4.1. Does the specificity of pain-related rules matter in chronic pain? We argue that verbal rules may vary from specific to general. General rules may explain why and how certain pain-related responses: (a) are transferred to situations or stimuli that have not been encountered in the past and (b) have the potential to (negatively) impact many different areas of daily functioning (e.g., [46,66]) (see section 3.1). Experimental research could manipulate the specificity of pain-related rules and demonstrate that, as the generality of those rules increases, so does the impact of the rule on different aspects of pain-related behavior (e.g., the rule is applied to a wider range of stimuli, is more difficult to extinguish, comes to control many different thoughts, feelings, and actions). Others could examine how general vs. specific pain-related rules are acquired in daily life and how and why specific rules are transformed into general ones. A number of experimental tools have been developed outside of the pain literature that could be used to examine the origins and persistence of specific vs. general rule-following (see [76,92]). Questionnaire designs (e.g., correlational or longitudinal) could also be used wherein people with chronic pain are asked to report on the general vs. specific rules they are following in pain-related situations. This could be achieved by modifying existing items from self-report measures (e.g., Fear of Pain Questionnaire [78]) to better reflect potential pain-related rules or by varying the range of applicable stimuli and situations.

4.2. Is pain-related rule-following context-dependent? Future research could identify how, when, and why pain-related verbal rules are elicited and followed (see section 3.2). As we previously mentioned, there are many factors that likely moderate rule-following: from the stimuli

(e.g., painful or valued activities) and responses that make up the rule (e.g., avoiding or engaging in those activities), to the context in which the rule takes place (e.g., at work, school, or at home; while experiencing high or low intense pain). In addition, the characteristics of the rule-provider (e.g., credibility) and the rule-follower (e.g., historical experiences with following a rule, personal goals and values, and developmental or cognitive abilities), and how the individual appraises the context (e.g., safe or threatening) could also differentially affect rule-following. Another particularly important moderator of rule-following could be the social context. When it comes to chronic pain in children or adolescents, for instance, parents play a crucial role in instructing pain-related verbal rules and reinforcing rule-following in their children. As children grow older, other people (e.g., friends, teachers, partners) might become additional rule-providers and their reactions to the pain also increasingly matter. In recent years, efforts have been made within the chronic pain literature to highlight the crucial role that others play in (problematic) pain-related behavior (e.g., see research on the role of parents of children with chronic pain as described by the Interpersonal Fear Avoidance Model [28] or on the role of partners of people with chronic pain [47]). Future research could explore when, why, and how people in the social environment contribute to either adaptive (e.g., if a doctor gives the advice to avoid doing sports while in pain but to not avoid going to school) or maladaptive forms (e.g., if parents instruct their child to always ignore/avoid pain) of pain-related rule-following in people with chronic pain.

Experimental studies could also explore if the source of the pain-related rule (a rule originating in oneself vs. instructed by others) determines the extent to which it is followed [44]. Previous work on rule-following (outside the pain context) has argued that familiarity and credibility of the interpersonal source plays an important role in this regard [80]. If the social context moderates pain-related rule-following as we suspect, this would highlight ways to increase the

effectiveness of treatment strategies that rely on instructing patients how to deal with their pain. For instance, important others and/or familiar social agents (e.g., parents, partners or peers) could be utilized as agents of change in chronic pain treatments (e.g., [47,49,67]).

Along with the experimental approach, there are other ways of measuring and manipulating the context-dependency of rule-following. One such approach is a longitudinal design that allows to study the interaction between different contextual factors across multiple moments in time. The daily diary method is one such an example [5]. Several studies have already shown the potential of a diary approach when applied to the study of chronic pain and its impact on daily functioning (for a review see [51]; [72 71 37]). Future work could probe to see what verbal rules people with chronic pain naturally use, and how they respond based on those rules. Such a design could also incorporate, and control for, daily contextual variables such as time, location, and/or activities to examine if and how these impact changes in pain-related behavior (Beeckman, 2018). Further, lagged analyses (e.g.,[37]) could be used to explore moment-to-moment relations between these variables. This approach could provide a naturalistic and ecologically-valid examination of the function of verbal rules and rule-following (i.e., their potential antecedents and consequences) in daily life and thus complement experimental or cross-sectional designs [5]. Note that although diary methodology reduces memory biases that might distort self-report questionnaires, they still require people to be explicitly aware about the rules that they are adhering to at the moment [5,61], which is considered to be a general challenge when using self-report measures. We discuss alternative procedures to assess automatic/implicit rule-following in section 4.5.

Another interesting methodology for studying pain-related rule-following is a network analytic approach (i.e., a statistical approach which involves a simultaneous analysis of the relations between multiple items or constructs in order to obtain a visualization of the network of

associations between them) [20]. Network approaches have recently gained popularity within psychology when studying the structure of interrelations between psychopathology symptoms, or between items of questionnaires (e.g., [9,10]). This approach could also be a better way to visualize and test the network of associations between pain-related rules, their (potential) antecedents, and consequences in specific contexts instead of focusing on (unidirectional) associations between two variables (e.g., fear and avoidance [46]). Network analytic techniques are especially useful when exploring new, data-driven hypotheses about the central role of certain (pain-related) factors or bidirectional relations between them[10]. Doing so could provide insight into the contextual factors (i.e., antecedents and consequences) which may give rise to and drive chronic pain-related functioning and rule-following. They would also signal potential factors to be intervened upon in order to promote adaptive functioning *and* reduce the risk of maladaptive outcomes for a specific individual.

4.3. Does pain-related rule-following make people insensitive to its consequences and other ways of acting? We have argued that rule-following can have short- and long-term consequences, and that it can make people insensitive to other ways of (valued) acting, or even the (aversive) consequences of their own rule-based actions. Although recent treatment approaches to enhance adaptation to chronic pain rely on similar assumptions (e.g., ACT [54]), and research has alluded to this rule-based insensitivity effect as a way to better understand why some people persist in seemingly "maladaptive" behaviors[17], this has never been systematically examined in the context of chronic pain (although for preliminary work see [16]). Future research could incorporate designs with measurements at multiple time points (e.g., prospective or diary studies) which are capable of investigating the temporal dynamics of pain-related behavior as a function of its short- and long-term consequences in real life. They could explore when responses to one type of pain-related

verbal rule (e.g., avoidance) can lead to immediate appetitive consequences but have aversive effects on the long-term, or how those same rules can lead to short-term negative outcomes and long-term appetitive outcomes.

Notably, to the best of our knowledge, past work on rule-following has usually confined its scope to a single experimental session and rarely incorporated pain as a consequence [17]. Future work could examine how the short-term consequences of adhering to (pain) avoidance rules can cause people to become stuck in following rules, even when such rules have maladaptive consequences in the long run. This work could also assess whether people are (a) fully aware of the long-term consequences of their pain-related (avoidance) behavior but simply choose to disregard these because the short-term consequences are appetitive, or (b) do the short-term consequences simply reduce awareness of the long-term consequences altogether? Addressing such questions would help us better appreciate how rule-following leads to maladaptive functioning in the presence of chronic pain. This work could utilize experimental procedures that have previously been used to investigate rule-based insensitivity in other clinical (e.g., schizophrenia [58]), subclinical (e.g., depression [52]) or non-clinical samples [65]. These results seem to suggest that psychological suffering may be related to persistently adhering to initially effective rules and being insensitive to the long-term negative consequences of doing so. Future studies could investigate if this becoming stuck in 'what worked before' (even when doing so leads to negative outcomes and blocks engagement in more adaptive behaviors) is central to psychological suffering in chronic pain. However, there are also some challenges that should be considered while experimentally investigating rule-following. For instance, work on this topic has shown that when people are asked to follow an instruction that this does not necessarily imply that they will act in accordance with

what they are told [75]. One should also be aware that demand characteristics in experimental settings may have a strong influence on if and why people follow a rule [64].

4.4. How does rule-following relate to (mal)adaptive functioning in chronic pain? In point 3.6 we introduced the idea that inflexible adherence to pain-related rules despite their negative consequences may be a risk factor whereas the ability to flexibly switch between pain-related rules depending on contextual demands may be key to resilient functioning in the presence of chronic pain. So far this idea remains speculative. Future research could empirically examine (in)flexible rule-following and its relationship to daily pain-related functioning in those with chronic pain. Studying flexible and inflexible rule-following requires several steps. First, one needs ways to assess flexible and inflexible rule-following. Again, a daily diary approach could be used to unpack flexible rule-following processes at the daily level. For instance, day-to-day variability in rules and rule-following could indicate how flexible people are in switching between rules.

As we previously mentioned, there might be a link between flexible rule-following and the concept of psychological flexibility. Specifically, we believe that flexible rule-following might be an important component of psychological flexibility. Most studies exploring psychological flexibility in people with chronic pain have restricted itself to the use of self-report questionnaires, mostly administered at one moment in time (e.g., [53,74,91]). However, if psychological flexibility involves - amongst other things - the ability to engage in flexible rule-following, this might open the route to other research methodologies to further unpack this broad, dynamic concept. For instance, longitudinal research could examine if and how scores on psychological flexibility questionnaires are associated with flexible pain-related rule-following and functioning over time in individuals with chronic pain.

4.5. Can pain-related rules be elicited and deployed automatically? When carrying out the above work it can be meaningful to learn from other developments taking place elsewhere in the larger psychology literature. One such development is the availability of procedures that assess people's automatic thoughts, feelings, and actions (i.e., implicit measures). Indeed, for many years now, chronic pain research has almost exclusively relied on direct procedures such as questionnaires and focus groups which assume that people have introspective access to, and control over, the content under investigation. Yet, we know that other factors such as social desirability can influence how people respond in these tasks [23,63]. People also often lack awareness of (a) the factors that caused them to respond in a certain way, or (b) the fact that they are even responding in a certain way.

On the one hand, many verbal rules seem to be elicited in a slow, thoughtful, deliberate, and controlled manner. These non-automatic rules can also lead to responses that are emitted in a similar, non-automatic and controlled way. These latter responses are often called 'explicit' responses and represent the main class of responses that are studied in the domain of chronic pain [46]. On the other hand, verbal rules could also be elicited in a quick, unintentional, unaware, and uncontrolled manner. These automatic rules may also give rise to responses that are elicited in a similar, automatic and uncontrolled way. These latter responses are usually described as 'implicit' or automatic responses [63].

Research has shown that these implicit responses can differ from what people explicitly report, and that they sometimes predict behavior in ways that self-reports do not (e.g., prediction of suicide attempts [62], romantic breakups [45] or children's intergroup attitudes [55]). Implicit measures may open up a largely unexplored avenue in chronic pain research – namely implicit or automatic rule-following in individuals with chronic pain. Considering this topic reveals interesting new

questions: can pain-related rules be elicited automatically, and can those rules trigger thoughts, feelings, and actions that occur quickly, without intention, awareness, or control? Are automatically deployed rules or responses more predictive of future outcomes than people's self-reported behavior or non-automatic actions? Or, can people learn to fear or avoid pain-related stimuli based on what they observe, all without verbally reflecting on what they are observing (i.e., generating a rule)? Likewise, is there a difference between newly learned actions and actions which have been exhibited frequently in terms of reflecting on the rules that are followed? Implicit measures such as the Implicit Association Task (IAT;[31]), Affective Misattribution Procedure (AMP; [68]), and others could be incorporated into work examining the antecedents and consequences, impact of long vs. short-term consequences, the insensitivity effect, and (in)flexible rule-following in the context of pain on an implicit or automatic level.

4.6. Open questions. A number of other avenues are also worth investigating. For instance, we still don't know if the typical problems we observe in chronic pain patients (stemming from their direct pain experiences) can also be established or even undermined by mere instructions or rules alone. In other words, is it the case that direct and indirect learning about pain produce similar outcomes? The same goes for other indirect learning pathways such as observational learning: can pain-related problems emerge by merely watching others interact with pain-related stimuli without the person having any direct experiences with those stimuli themselves? How do direct and indirect learning pathways *interact* in the context of pain? Throughout this paper we focused on how verbal rules and instructions alone can give rise to pain-related behaviors without the need for any prior contact with pain. But it is also likely that those same verbal processes *interact* with prior pain experiences and shape people's subsequent thoughts, feelings, and actions. It is also likely that different indirect learning pathways (e.g., language versus observation) can also interact to shape

pain-related responding. For instance, what happens if parents verbally instruct their child to engage in activities despite the pain (rule), but the child sees that their parents do not engage in activities themselves when they are in pain (observation)? What is clear is that we have only scratched the surface of this topic and that the singular and interactive role of different learning pathways in pain still remains to be studied.

Part V: Clinical Implications

The aforementioned ideas also have implications for clinical practice. First, the study of pain-related rules could help address some of the questions that have long puzzled research and practice in chronic pain [15,25–27]. For instance, it has been difficult to effectively generalize the impact of exposure treatment to other pain-related movements, activities or situations [15,25,27]. Researchers have attempted to increase the number of contexts and stimuli in which exposure was trained to solve this problem of generalizability. However, studies have shown that such experiences are often insufficient to reduce or eliminate pain-related fear or avoidance [25]. Future pain-related exposure strategies could incorporate the possibility that general rules and inflexible adherence to these rules might be responsible for the problems with generalizing learning effects. For instance, therapists could increase patients' awareness about the effects of general rules on their behavior and inform them about their own ability to follow these rules or not. Additionally, exposure therapies aimed at reducing fear and avoidance could try to establish new rules during, or prior to, exposure treatment to broaden the individual's repertoire of pain-related responses.

Second, clinical strategies could try to enhance people's ability to observe what rules are elicited in the presence of pain and how they could flexibly switch between them. Psychological therapies could be aimed at increasing people's sensitivity to the consequences of their inflexible rule-following behavior. New methods could be developed to train flexible rule-following in

people with chronic pain in order to promote adaptive functioning. One possible method which we believe has potential to meet this aim is the use of a serious game (i.e., a computerized game that can be used as an educational or treatment tool) [24,73]. Recent work shows that serious games have positively impacted other domains of health care (e.g., anxiety treatment in children with autism [93]). We know of one study that has developed a serious game which focusses on the motor rehabilitation of chronic pain patients [73]. However, the avenue for applying serious games to the psychological treatment of chronic pain is still open. This could for instance be done by creating a game in which people with chronic pain are asked to create a computer version of themselves (an avatar). During the game their avatar is instructed to avoid or engage in many different pain-related activities (e.g., physical, social) and learn about the consequences of doing so. This method would allow for a whole range of contextual factors to be manipulated in a relatively easy way. For instance, the consequences of either following a pain-avoidance (e.g., *"I should avoid doing this activity"*) could be manipulated so that it is either appetitive or aversive in situation 'A' (e.g., going to a party with friends). In situation 'B' (e.g., participating in a new sport with new people) the consequences of following these same rules can be manipulated so that they are different or even opposite to those in situation A. This game could be used as a tool to help inform patients with chronic pain about the importance of paying attention to the rules governing their behavior, the consequences of following those rules, how they can make them insensitive to other opportunities or ways of acting, and the benefits of flexible switching between rules depending on the specific situation. The use of real-life examples may also help motivate patients and allow them to more easily generalize what they have learned to their daily lives as well.

Finally, existing therapeutic approaches such as Acceptance and Commitment Therapy (ACT, see [81] for a detailed discussion) have already implemented some of these recommendations.

ACT has become increasingly popular in the treatment of chronic pain related problems (e.g., [32,69]) and its core assumptions are closely linked to RFT. Yet many ACT practitioners do not rely on developments in RFT but instead focus on concepts that are central to psychological flexibility which were constructed to facilitate communication with the patients [53]. However, we believe that it is important that all clinicians who apply ACT or its various concepts, such as acceptance and value-based action, should have insight into the literature on the theory underlying this therapy (i.e., RFT; for more detailed reflections about the gap between RFT and clinical practice see e.g., [2,84]). This could improve the ability of clinicians to reflect and make theory-based predictions about the factors that maintain pain-related behavior. We hope this paper provides a first step to bridging this gap between applied and basic research in the chronic pain domain.

Conclusion

The current paper is a call to arms for researchers and clinicians to consider the role that indirect contact with pain in general, and verbal rules in particular, play in (mal)adaptive functioning in the context of chronic pain. We argue that verbal rules and rule-following, as conceptualized within Relational Frame Theory, provide important new insights into the origins of pain-related behaviors and the factors that maintain them. Although verbal rules are often adaptive, they are a double-edged sword insofar as they increase the risk that people will become insensitive to the consequences of their rule-following and ways of acting. Persistent and inflexible rule-following despite the negative consequences may be proven helpful for understanding maladaptive functioning in people with chronic pain. Likewise, flexibly adhering to, and switching between, different types of rules (e.g., pain-related avoidance versus acceptance rules) based on their consequences may be key to adaptive functioning. Future research should systematically examine the role that rule-following plays in the context of chronic pain, investigate how (in)flexible rule-

following and rule-based (in)sensitivity emerge and are maintained, and assess how these factors are related to (mal)adaptive outcomes in the presence of chronic pain. We provide a road-map for that work and showcase why it matters for research and practice.

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