Social touch types [9]
Contact, Finger interlocking, Hit, Hug, Kick, Lift, Massaging, Nuzzle, Pat, Picking, Pinching, Poking, Press, Push, Rub, Scratching, Shake, Slap, Squeeze, Stroke, Swing, Tap, Tickling, Toss, Trembling
Touch types in experiencing textile [1]
Two Fingertip stroking, Palm and thumb rub, Edge stroke between forefingers, Thumb and forefinger pinch, Slide between forefingers, Grab and stroke with palm, Put hand inside twist and run other hand over, Turn inside out then thumb and forefinger rub, Full hand edge stroke, Multi fingertip flick, Open handed stroke, Multi fingertip stroke, Grab edge and scrunch, Hand inside pat, Thumb and forefinger edge stroke, Thumb and forefinger edge rub

Table 1. Touch types investigated in [9,1].

It's not just what we touch but also how we touch it.

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Abstract
Literature on affective touch shows that an affective language of touch exists. We communicate and read others' emotions through touch to the same extent that we communicate emotions through facial, vocal and body expressions. Touch patterns similar to those observed in social interactions emerge when interacting with objects. In this paper, we argue that a tactile measure of experiences should consider both what we touch and how we touch it. The characteristics of tactile behavior provide a multimodal dimensional space to more fully capture the richness of a person's emotional experience. This is the case for both consciously and unconsciously (i.e., less stereotypical) instantiated tactile expressions.

Author Keywords
Affective touch behaviour; user experience; measures.

ACM Classification Keywords
H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

Introduction
Describing our emotional state is not an easy task. We often cannot find the words that fully capture it. Isbister et al. [11] explored the possibility of selecting and touching objects of different shapes as a way to

Emotion	Touch type
Anger	Hit, Pat, Push, Shake, Squeeze
Fear	Contact, Lift, Press, Shake, Squeeze
Happiness	Hug, Lift, Pat, Shake, Squeeze, Swing
Sadness	Contact, Hug, Lift, Nuzzle, Rub, Squeeze, Stroke
Disgust	Contact, Kick, Lift, Push, Shake, Slap, Toss, Squeeze
Love	Contact, Hug, Lift, Pat, Press, Shake, Stroke, Tap
Gratitude	Contact, Hug, Lift, Pat, Shake
Sympathy	Contact, Hug, Pat, Rub, Stroke

Table 2. Touch types to convey emotions in social contexts (summarized from [9]).

express our emotions. Exploiting synesthetic processes, emotional experiences are translated into shapes and the experience of touching those shapes. In this paper we support the use of "touching" physical objects as a powerful, intuitive and possibly less-culturally based [10] (than language) way to convey insight about one's personal experience. But we argue that touch is a complex expression and that its complexity should be considered as an important part of the measure. That is, it is not just *what* we touch but also *how* we touch that explains what we feel. In the rest of the paper, we discuss the touch behavior dimension that are important to capture what touch expresses, why it is critical to consider them, and what factors may affect them. These aspects may inform the design of tactile-based UX measures as well as the objects to touch.

Touch as a multidimensional affective signal

Recent works in affective science have reconsidered touch as a rich expressive modality. They show that touch does not only convey the intensity of an emotion, as previously thought, but also its valence and possibly other affective dimensions (e.g., action tendency). For example, Hertenstein et al. [9] showed that people could discriminate the affective meaning of tactile messages (e.g., a gentle tap on the shoulder) with recognition accuracy levels comparable to those observed for other affective modalities [9,12]. HCI studies have also shown that people develop affective tactile language even through interaction with objects. For example, the handling of an e-scarf was used in [3] to transmit affective tactile messages to a partner.

Rather than being a one-dimensional signal (i.e., what we touch), affective touch is characterized by a set of dimensions whose instantiation clarifies its meaning providing a wider, even if not fully deterministic, language of emotions. Hertenstein et al. [9] investigated 25 types of touch in a social context (Table 1 – top). Their findings showed, first, preferences for the type of touch used to convey a certain emotion (Table 2); second, a relationship between the location of the touch on the other person's body and the way the emotion was interpreted; and third, that the interpretation of the tactile message was strongly based on its kinematic properties (length, duration, pressure, directions), as displayed in Figure 1. Our study on the design of touch-based devices to interact with digital textile show that consumers use a rich variety of touch types to experience textiles [1] (Table 1 – bottom) and that some of these types are more enjoyable and engaging than others.

A relation between touch kinematics and expressed emotion is also supported by studies aiming to create systems that automatically categorize touch behavior into emotion categories or affective dimensions (see [8] for a review). These studies show that the emotion categorization can be done both for acted affective expressions and for non-acted expressions. In the context of touch-based computer games, we showed that the touch kinematics (stroke speed, pressure, length direction) gathered by the game devices could be reliably mapped to self-reported emotions at the end of each short game session [8]. The emotion-touch profiles that emerged (Figure 2) validate touch as a modality for evaluating the player's experience. These touch-emotion profiles show also similarity with affective body movement profiles [12], suggesting touch could in part be considered as an extension of body movement. As such, its kinematics may allow for the clustering nuances of people's emotions [6].

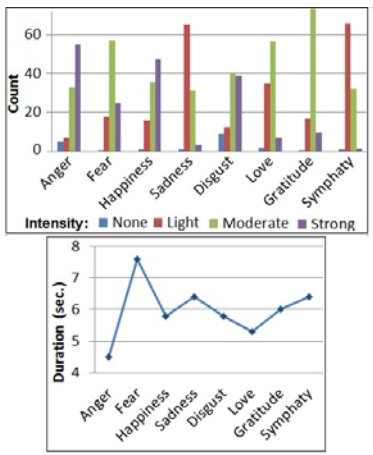

Figure 1. Tactile behavior in social touch (summarized from [9]).

It is important at this stage to consider that emotion-based kinematic profiles may not directly transfer from one type of touch to another and that they may need to be separately investigated instead. In fact, when comparing the results obtained for different touch types (stroke, tapping/dotting and social touch) from various studies (see [8] for a review), we notice some differences in their kinematic profile with respect to the same emotion. In a localized type of touch behavior (e.g., tapping), frequency may play a more important role than it plays in a touch behavior expressed over a larger surface (e.g., stroking), where duration may instead be of importance. It should be also noted that these mapping are far from deterministic. Individual differences (e.g., sensitivity of the skin) [8], culture and context of use may contribute to shaping it. In [13], pairs of subjects developed a touch language over weeks to send each other affective signals through a haptic phone. Vetere et al. [15] discusses how language emerges as an expression of intimacy. These studies highlight another dynamic dimension of touch, capturing its emergence and specialization over time.

Factors affecting tactile behaviors

If one is to exploit touch as a UX measure, it is important to be aware of some important factors that affect tactile behavior, other than the emotion we are experiencing. Among these factors, both the expectations we have about the experience of touching an object and the perception of the material as we touch the object influence *how* we touch it. Regarding sensory expectations, various studies have shown that introducing conflicts between these expectations and the sensory feedback we get from interacting with objects shape the kinematics of touch movements. For instance, presenting on movement onset the sound that will be produced by touching either the material of the object, or a different material, determines the speed of the reaching-to-grasp movement [5]. In addition, in our study [7], we showed that conflicts in the sound feedback on applied strength when tapping on a surface result in changes in the acceleration of the tapping movements, and in the self-reported emotional valence, as if one would be trying to compensate for the sensory conflicts.

Regarding the perception of object material, we showed that altering (by means of sound) the perceived texture roughness of a surface being touched changes touch velocity and the pressure applied when touching (submitted). Similarly, changing (by means of sound) the perceived floor material influences the walking style [4]. Note that often a material perception-motor loop is established, by which a perceived material changes touch behavior, but touch behavior further changes the perceived material [14]. Emotion is intricate in this material perception-motor loop. Whilst in these studies, touch behavior was purposely altered by changing expectations and perception, these phenomena are important when considering touch as UX measure. The experience to be conveyed may lead a person to focus on some aspects (texture rather than shape) of the object and this focus may affect the touch behavior. A similar phenomenon was observed when selecting images (eye path) for expressing emotions (e.g., [2]).

Conclusions

In this paper, we support the use of “touching” objects as a powerful UX measure, but argue that, to get a full picture, we need to consider touch dynamics (as well as UX dynamics [16]). It’s not just *what* we touch but also *how* we touch it. The studies presented here highlight

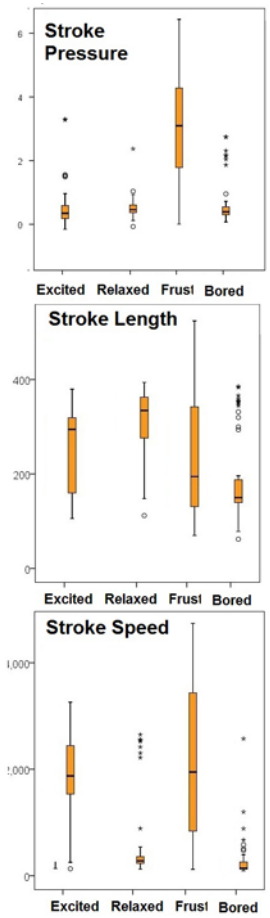

Figure 2. Kinematics of naturalistic affective touch behavior in touch-based games (adapted from [8]).

Touch kinematic profiles: stroke pressure discriminated frustration from other states; stroke length separated positive from negative emotions; speed discriminated along the arousal dimensions. The direction of the stroke (see [8]) was also informative even if to a lesser extent.

the complexity of touch signals either acted to purposely express an emotion or unconsciously expressing it. The type of touch, the location where touch happens and its kinematics provide rich insights into someone emotional experience. At the same time, this multidimensionality requires to carefully consider the objects that are used to elicit touch. Their properties (e.g., shape and material) should allow for the variety of affective touch behaviors used to express the investigated experiences. Attention should be also given to the fact that object material shapes the dynamics of touch behavior and hence may affect the experience over time. As touch becomes a main interacting modality, the objects forming the environment to be experienced (and hence evaluated) become the source for UX measures. The way people touch them may directly provide information about how they feel without interrupting the experience and at the same time measures the dynamics of the experience [16]. Touch profiles changing over time could also capture touch languages emerging between people and (physical or virtual) agents in the environment.

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