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Brief Report

Individual differences in the relationship between pleasure and arousal

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Abstract

The two fundamental dimensions assumed to underlie emotional experience—pleasure and arousal—are considered to be independent across individuals. We present evidence from an experience sampling study demonstrating that this independence does not necessarily hold when considering the affective experiences of a single individual. Participants ($N = 80$) reported how they were feeling in terms of pleasure and arousal nine times a day for seven days. The data showed that, although on average pleasure and arousal were independent, within-person pleasure–arousal associations substantially varied and ranged from strongly positive to strongly negative. This finding demonstrates that pleasant/unpleasant feelings usually co-occur with high arousal for some (reflecting joy/stress), but with low arousal for others (reflecting relaxation/sadness) and that persons differ in whether arousal is usually pleasant or unpleasant. These differences were found to be related to dispositional reward responsiveness, with high reward responsive individuals being characterized by a positive relation between pleasure and arousal and vice versa.
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1. Introduction

Research has shown that the fundamental building blocks of emotional experience and moods can be captured by the dimensions of pleasure (or valence) and arousal (or activation) (Feldman Barrett & Russell, 1999; Russell, 2003). This means that at each point in time a person's feeling state can be parsimoniously defined in terms of how pleasant and aroused he or she feels, something which has been labeled core affect (Russell, 2003).

Considered across individuals, pleasure and arousal are found to be independent (e.g., Feldman Barrett & Russell, 1999). Yet, this does not necessarily imply that this is also the case when considered within one individual (across time or circumstances). As pointed out by many authors in many contexts, a particular association between two variables across individuals (at the trait level) does not imply the same association

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within an individual (at the state level). For instance, in the affective domain, studies by Zelenski and Larsen (2000) and Vansteelandt, Van Mechelen, and Nezlek (2005) have illustrated this point with respect to the relation between positive and negative emotions.

In the present study, we argue that the relationship between the fundamental affective dimensions of pleasure and arousal does not necessarily has to be independent within one person, and that this relationship can vary across individuals. In other words, it is possible that for some arousal and pleasantness are positively related, for some they are independent, whereas for others they are negatively related. This would mean that for some individuals, pleasant feelings may be more likely accompanied by high arousal (positive relationships between pleasure and arousal), reflecting joy and excitement, whereas for others pleasant feelings may be more likely accompanied by low arousal (negative relationship), reflecting relaxation and contentment; in terms of unpleasant feelings, some individuals would be more likely to experience unpleasantness in terms of sadness and depression (positive relationship between pleasure and arousal), whereas others more in terms of stress and anxiety (negative relationship). Likewise, this would mean that for some individuals arousal may more likely be experienced in combination with pleasant feelings (positive relationship), and for others more likely in combination with unpleasant feelings (negative relationship), which echoes proposed distinctions between two types of arousal, energetic and tense arousal (e.g., Thayer, 1986; Watson, Wiese, Vaidya, & Tellegen, 1999).

The existence of variability in this relation implies that the shape of affective space, and consequently the range of possible affective experiences can differ considerably from person to person (see also, Larsen & Cutler, 1996). In this respect, Feldman Barrett (Feldman, 1995; Feldman Barrett, 1998) previously identified individual differences in valence and arousal focus, reflecting how much individuals attend to the hedonic (pleasure–displeasure) and arousal components of their affective experiences. This research has convincingly demonstrated that the affective experience of different persons can be structured (or constrained) differently such that certain feelings (or the variability therein) are more emphasized in affective experience for some but not for others. Our proposal takes the idea of individual differences in the structure of affect one step further by suggesting that how pleasure and arousal are interrelated can vary significantly from one person to another. Researchers have so far largely neglected the nature of the intraindividual relation between pleasure and arousal. Yet, the study of this issue is important because it may provide valuable knowledge on how to chart and understand the emotional experience of individuals as well as yield important implications for theories on the structure of affect.

With this study, we aim to examine individual differences in the intraindividual relation between pleasure and arousal. On average, we expect that the two dimensions are independent, given their independence across individuals when based on single-occasion assessment. We expect to find interindividual differences in this relation, however, with pleasure and arousal being positively, not, or negatively associated for particular individuals. Additionally, we want to account for these individual differences by examining the role of reward responsiveness in determining the relation between pleasure and arousal. Reward responsiveness is a component of the behavioral activation system (BAS; e.g., Gray, 1990) and is considered to reflect the degree of activation or goal striving in conditions of reward or opportunities to avoid or stop punishment (Carver & White 1994). Therefore, we expect that individuals high in reward responsiveness will be characterized by a positive relationship between pleasure and arousal because they are more likely to experience high levels of activation and arousal in combination with pleasant states, because for these individuals pleasant states generate arousal and activation derived from BAS activity. In contrast, we expect that individuals low in reward responsiveness will be characterized by a negative relationship between pleasure and arousal because they tend to experience low levels of arousal or activation in combination with pleasant states.

To test our hypotheses, we analyzed data from an experience sampling study in which participants provided momentary pleasure and arousal scores for several times a day over the course of a week.[1] The advantages of this technique is that assessment occurs in the course of real-life circumstances of the participant, allowing researchers to collect ecologically valid data across a broad range of different circumstances (Feldman Barrett & Barrett, 2001). Moreover, participants are required to record their affect at the moment of the sampling

[1] Part of these data are also reported in Timmermans, Van Mechelen, and Nezlek (submitted for publication) in a study on the prediction of core affect on the basis of situational appraisal and personality.

itself instead of having to rely on memory, hereby eliminating cognitive biases of information storage and retrieval (e.g., Stone et al., 1998).

2. Method

2.1. Participants

Participants were 80 university students from the Katholieke Universiteit Leuven. They were recruited via the university job service and were paid for participation. On average, participants were 22 years old, and 48 (60%) of the participants were women.

2.2. Materials

2.2.1. Assessment of pleasure and arousal

Feeling states at each sampling moment were recorded using the *Affect Grid*, a single-item measure designed to assess core affect (Russell, Weiss, & Mendelsohn, 1989). It is a visual 9×9 two-dimensional grid, with a neutral (fifth) row and a neutral (fifth) column. Unpleasant/pleasant feeling forms the horizontal dimension, arousal/sleepiness the vertical, such that each position on the grid corresponds to a particular pleasure and arousal score. Endpoints and neutral points are marked with emotion words to facilitate reporting. Participants were instructed to mark the position in the Affect Grid that best corresponded to how they felt at each sampling moment.

Participants were also asked to report at each beep the actual time they completed the form. This was done to ensure that the participants filled out the reports at the time of beep instead of providing retrospective reports (for which they would be obliged to memorize the exact time they were beeped), and consequently to exclude data that were recorded outside an interval around actual beep time. Following Hektner and Csikszentmihalyi (2002), data were included in the analyses only if the reported time fell in a [−5; 10] min interval around the original programmed time. In total, 93 percent of reports were provided within the specified timeframe and used in further analyses.

2.2.2. Reward responsiveness

Reward responsiveness was assessed using the Dutch translation of Carver and White's (1994) BIS/BAS questionnaire (Smits & De Boeck, 2006). The questionnaire consists of 24 items that form one behavioral inhibition system (BIS) scale (seven items) and three BAS scales—drive (four items), fun seeking (four items) and reward responsiveness (five items). The responses were collected using a four-point scale (1 = strongly agree to 4 = strongly disagree). In order to obtain scale scores, the respective item scores were reversed (such that higher scores reflect stronger endorsement) and summed.

2.3. Procedure

During an introductory session, participants received information about the study, a programmed Casio PC Unite© wristwatch, and seven diary booklets (one for each day of the study). The wristwatch was programmed to beep nine times a day for seven consecutive days. Beeps during the day were semi-random. The available time was divided into equal intervals, and a random beep was scheduled in each interval. During the introductory session, the Affect Grid was explained to participants using the instructions provided by Russell et al. (1989), and participants completed some sample grids under the supervision of the experimenter. Participants also completed the BIS/BAS questionnaire. The study began on the day following the introductory session. Participants wore their watches during their normal daytime routine, and at each beep they recorded their momentary core affect and the time. At the end, participants returned their watches and received payment. Payment was based on a variable payment scheme, which had been explained to the participants at the introductory session. Participants could earn a maximum of 20 EURO: 12 EURO for compliance with the procedure, plus a one-EURO bonus for each day with 8 or 9 answered beeps and another one-EURO reward if this happened regularly. On average, 59 of the 63 reports were completed.

Table 1
Results of multilevel regression analysis predicting arousal scores on the basis of pleasure scores with reward responsiveness predicting the random slope of pleasure

	Fixed		Random	
	Coefficient	*T*-ratio	*SD*	χ^2-value[a]
Beep level				
Intercept	0.26	3.31***	0.62	443.99***
Pleasure	0.03	0.87 ns.	0.27	367.49***
Person level				
Reward responsiveness	0.19	2.02*	—	—

[a] The χ^2-value is calculated as the difference between −2LogLikelihood (deviance) of a model including and a model excluding the random term; associated *p*-values were calculated on the basis of a mixture χ^2 sampling distribution (Molenberghs & Verbeke, 2004).
*$p < .05$, ***$p < .001$.

3. Results

Given the nested data structure (sampling moments within persons), a multilevel regression analysis was conducted to analyze the data. A random effects model was specified in which arousal scores were predicted by pleasure scores, including a fixed and random (across persons) intercept and regression coefficient (or slope). The fixed regression slope reflects the overall association between pleasure and arousal, whereas the random slope reflects individual differences in this association. Reward responsiveness scores were included as a covariate predicting the random slope at the person level. The results can be found in Table 1. First, the fixed regression coefficient amounts to 0.03 and was not significant, meaning that on average, pleasure and arousal are independent. Second, as indicated by the significant standard deviation of the random slope (equaling 0.27), this association varied significantly across participants. To illustrate these individual differences, we calculated the zero-order correlation between pleasure and arousal for each participant separately. These within-person correlations ranged from −.58 to .61 (both $p < .001$), with an average of .03 (*ns.*), demonstrating that the within-person association between pleasure and arousal scores ranged from highly negative over zero to highly positive. Fig. 1 displays the distribution of these correlations across persons in the form of a histogram. As a graphical illustration, Fig. 2 provides scatter plots for participants with a high negative, a zero and a high positive correlation between pleasure and arousal scores. Finally, the random slope was significantly predicted by reward responsiveness (see Table 1), such that higher reward responsiveness was associated with a high positive association between pleasure and arousal and that low reward responsiveness was associated with a high negative association between pleasure and arousal. The reward responsiveness scale was the only scale from the BIS/BAS inventory that showed a reliable association with the pleasure–arousal relation.[2]

4. Discussion

Prior research has demonstrated that pleasure and arousal form independent dimensions underlying the structure of individual differences in momentary emotional experience. Yet, the question whether the relationship between these dimensions within individuals is of a similar nature has not yet been considered until now. In the present study it was demonstrated that, although on average independent, the intraindividual relation between pleasure and arousal varies considerably across individuals, ranging from highly negative over zero to highly positive. This means that for one individual, the experience of a pleasant emotional state may more

[2] When all BIS/BAS scales were entered separately, BAS reward responsiveness (see Table 1) but also BAS fun seeking (*T*-ratio = 2.01, $p < .05$) emerged as positive predictors of the pleasure–arousal slope. When all four BIS/BAS scales were entered simultaneously, the contribution of BAS reward responsiveness remained substantial (*T*-ratio = 1.90, $p = .06$) whereas that of BAS fun seeking strongly decreased to non-significance (*T*-ratio = 1.40, $p = .16$). In this simultaneous analysis the BAS drive subscale became a negative predictor (*T*-ratio = −2.21, $p = .03$), which is most likely due to suppression effects and should not serve to base valid conclusions upon. Taken together, only BAS reward responsiveness can be concluded to show a reliable association with the pleasure–arousal slope.

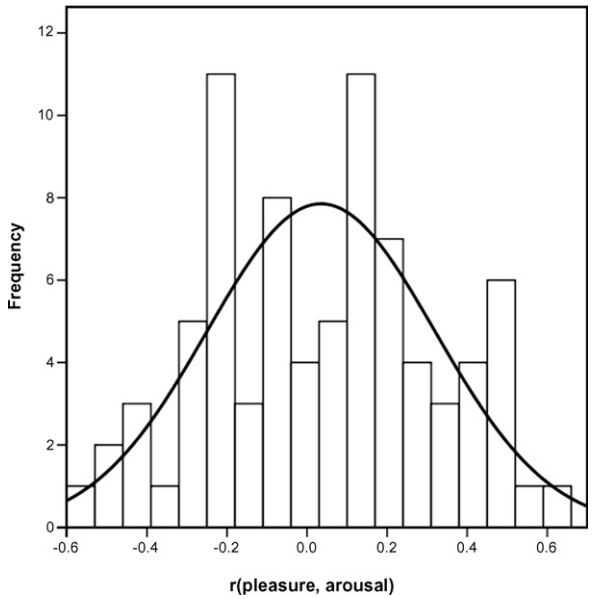


Fig. 1. Histogram displaying the distribution of within-person correlations between pleasure and arousal (for comparison, the full line represents an approximating normal curve).

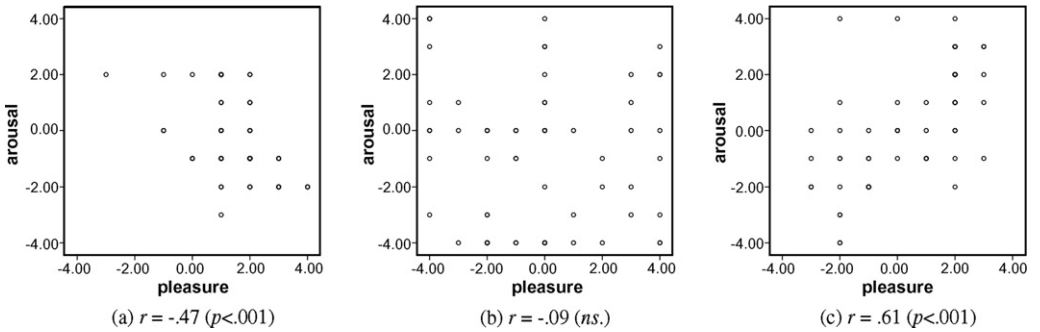


Fig. 2. Individual scatter plots of the relation between pleasure and arousal scores for a participant with (a) a high negative, (b) a zero and (c) a high positive correlation between pleasure and arousal.

likely be accompanied by high levels of arousal, whereas for another individual it may more likely be accompanied by low levels of arousal. As a result of this variation, for some individuals feeling pleasant usually implies feeling excited and enthusiastic, whereas for others feeling pleasant usually implies feeling relaxed and at ease. Conversely, unpleasant feelings are more likely accompanied by low arousal for some, implying feelings of sadness and depression, but by high arousal for others, implying feelings of anxiousness or stress. Yet for others, there may be no such systematic linear association between both. Instead, for such individuals, whether a pleasant state is accompanied by high or low arousal may be dependent on other factors such as context, culture (see, e.g., Tsai, Knutson, & Fung, 2006) or there may be a more complex (e.g., quadratic) relation between both. Given this variation, the relation between pleasure and arousal that characterizes an individual provides valuable insight into the kind of feeling states that are more likely to be experienced by an individual across time. Our findings demonstrate that how pleasure and arousal are related to one another represent an additional important source of variability in how individuals' idiographic affective experiences are structured. This type of variability has direct implications for the affective experiences that are possibly experienced by the individuals. As such, it goes to the core of what emotional experience is constituted of for different persons and thus to the very base of what "being emotional" means or can mean for different

individuals. As such, the results from this study complement previous findings by Feldman (1995) who identified individual differences in valence and arousal focus as factors that influence an individual's structure of affective experiences.

To account for the observed individual differences, we hypothesized that reward responsiveness, a component of the behavioral activation system, may play an important role in determining the relation between pleasure and arousal. Our results showed that high levels of reward responsiveness are related to a positive relation between pleasure and arousal and vice versa. These results suggest that the arousal that accompanies pleasant feelings for individuals that are characterized by a positive association between both may derive from BAS activity, generated by the presence of positive feelings or rewarding circumstances and aimed at energizing behavior and actively pursuing goals. For individuals characterized by low reward responsiveness, pleasant feelings may not signal such opportunities, but rather the possibility for relaxation, reflected in its association with lower arousal levels. Thus, the results suggest that pleasant affect may signal different things to different individuals: For some, it may act as a sign that things are going well, and that there is opportunity to engage in active behavior and goal-pursuit (i.c., high BAS reward responsiveness individuals). As a result, such individuals experience active, aroused pleasant affective states. For others, it may signal the opportunity to let down one's guard and relax now things are going well (i.c., low BAS reward responsiveness individuals). An implication of this finding may be that individuals characterized by different pleasure–arousal relations may engage in different types of behaviors when feeling pleasant. Individuals that are characterized by a positive association between pleasure and arousal may rather engage in active goal-pursuit behavior, whereas individuals that are characterized by a negative association may refrain from active goal-pursuit and rather "enjoy the moment".

There is an interesting parallel between our findings and recent work by Tsai and colleagues (e.g., Tsai et al., 2006). She demonstrated that culture influences ideal affect such that individuals from individualist cultures ideally prefer aroused pleasant affect, whereas individuals from collectivist cultures seem to prefer low arousal pleasant states. With individualist cultures being characterized by a strong emphasis on personal accomplishments, standing out, feeling energized, etc. (see also e.g., Elliot, Chirkov, Kim, & Sheldon, 2001), it is not unreasonable to assume that individualist cultures place a higher emphasis on reward responsiveness and goal striving in the possibility of reward. Our findings suggest that this in turn may cause the individuals from such cultures to prefer activated pleasant states (reflecting a positive correlation between pleasure and arousal as well as aroused pleasant ideal affect).

4.1. Limitations and conclusions

Although to date there is no viable alternative for knowing how people feel but to ask them, self-reports may be influenced by response tendencies or self-representational biases. We minimized the impact of such contaminating factors by explicitly guaranteeing anonymity to the participants, by using the Affect Grid as a low-demand tool to measure pleasure and arousal across multiple occasions, and by using experience sampling methods that assess participants' ongoing feelings in the circumstances in which they occur.

To conclude, it was demonstrated that the relation between pleasure and arousal can vary from strongly negative, over zero, to strongly positive when considering the affective experiences of one single person. Thus, feeling pleasant is more likely accompanied by high arousal for some, but by low arousal for others, and arousal is usually pleasant for some but unpleasant for others. This implies that the shape of affect space, and consequently the range of possible affective experiences and what "being emotional" means can differ considerably from person to person. Dispositional reward responsiveness (a component of the behavioral activation system) may play a role in these individual differences in that high reward responsive individuals were found to be characterized by a positive relationship between pleasure and arousal and low reward responsive individuals by a negative relationship.

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