Real-time Responses to Stories: Linking Valence Shifts to Post-Exposure Emotional

Flow and Transportation

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Abstract

Narrative experiences are characterized by dynamic emotional responses. Research has begun to investigate implications of emotional shifts for narrative processing, but the continuous measurement of emotion poses a challenge. This study examines how valence shifts captured using real-time response (RTR) measurement during two films relate to transportation and post-exposure self-reported emotional flow. Across both films, valence shifts (in terms of the mean intra-individual standard deviation of RTR valence) were positively correlated with transportation and self-reported emotional flow. Valence shifts and self-reported emotional flow were higher among women than men. We discuss the use of RTR measurement for the assessment of emotional shifts during narrative processes.

Keywords: Emotional Shifts, Emotional Flow, Transportation, Real-Time Response

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Stories are characterized by narrative arcs that imply dynamic emotional experiences on the side of recipients (e.g., Appel et al., 2019). Nabi and Green (2015) refer to these experiences as *emotional shifts* and propose influences on media selection, narrative processes and related effects. A major challenge in the study of emotional shifts is the measurement of emotions during multiple points in the narrative. The present study utilizes real-time response (RTR) measurement to capture valence shifts experienced during stories and to investigate their association with transportation (Green & Brock, 2000) and a post-exposure self-report measure of *emotional flow* (Authors, under review). Furthermore, we examine valence shifts and emotional flow with respect to possible gender differences. In addition to traditional null hypothesis testing, we report Bayesian statistics.

Emotional Shifts and Narrative Transportation

Emotional shifts refer to the changes in emotional states recipients experience in response to media messages. Shifts may occur between different discrete emotions (e.g., happiness and sadness) or as variation in the intensity of a particular emotion (Nabi & Green, 2015). From a dimensional view of emotion (e.g., Russell, 1980), shifts can be understood in terms of variation along the dimensions of valence and arousal. This study focuses on valence shifts, which may manifest as changes from positive to negative (and vice versa), or as changes in the intensity of positive and negative valence. In the following, we will use the term valence shifts rather than emotional shifts, except when denoting emotional shifts between discrete emotions. We further use the term *emotional flow* to refer to the "evolution of the emotional experience ... marked by a series of emotional shifts" (Nabi & Green, 2015, p. 143).

Transportation is conceptualized as a process in which all mental systems of a person become focused on the narrative events and is characterized by heightened attention towards

the story, the building of rich imagery, and engaging in perspective taking with the protagonists (Green & Brock, 2000). Nabi and Green (2015) argue that emotional shifts sustain narrative processes like transportation. This assumption is backed by the information processing literature, which suggests benefits of sequential activation of the appetitive and aversive motivational systems for cognitive resource allocation to the encoding of messages (e.g., Clayton et al., 2021). Because appetitive system activation occurs in response to pleasant messages (implying induction of positive emotional valence) and aversive system activation in response to unpleasant messages (implying negative valence), valence shifts elicited by stories may direct attention to the narrative. Furthermore, research on suspense suggests that emotional shifts in response to suspenseful stories (i.e., experiencing suspense resolution after fearing for protagonists, Zillmann et al., 1975) may underlie transportation into suspenseful narratives (e.g., Bezdek & Gerrig, 2017). Some initial evidence for the link between shifts and transportation is provided by Alam and So (2020), who found that stories representing a valence shift induced higher transportation than single valence stories, although this result may have been affected by the difference in story length between groups. More recently, Author et al. (in press) examined the relationship between transportation and emotional shifts for written narratives and measured emotional shifts using self-probed emotional retrospections. Participants marked an "E" at the text margin whenever they experienced an emotion in response to the story. After they finished reading, participants were asked to specify their emotional experiences during these occurrences. For both a fictional short story and a non-fictional journalistic narrative, the authors found that transportation was positively related to the intensity and the number of emotional shifts participants experienced while reading. However, further studies are needed to examine the relationship between shifts and transportation across different narrative media, particularly studies relying on continuous measures of emotion.

Measuring Valence Shifts and Emotional Flow

Studying the role of valence shifts for narrative processing requires to measure valence at multiple points of the narrative. Psychophysiological measures (e.g., skin-conductance levels, facial electromyography), facial expression analyses, or measures of brain activity (e.g., neuroimaging) offer the possibility to capture the valence and arousal dimensions of emotion as they occur (Mauss & Robinson, 2009), but require costly equipment and extensive training regarding application, data analysis, and interpretation. By contrast, real-time response measures using rating dials or similar devices to capture subjective emotional responses are comparatively accessible (Ruef & Levenson, 2007). Importantly, this method poses relatively little cognitive demand and thus, avoids interference with other narrative processes (Wagner et al., 2021). By allowing individuals to indicate emotional responses in the moment they occur, memory biases observed with retrospective self-reports of emotion are avoided. Finally, shared methods to measure two constructs (e.g., two self-report scales) may systematically affect correlations between these variables (common method bias, Podsakoff et al., 2003). RTR measures of emotion help to avoid this problem in studies that are otherwise relying on self-report to measure narrative processes and effects.

Emotion data gathered using RTR measurement is open to several data analytic strategies, depending on a study's research questions (see Ruef & Levenson, 2007). To operationalize shifts, difference scores of average emotion ratings before and after a predefined point in the narrative may be computed (e.g., Siegenthaler et al., 2021). This approach is useful in experimental contexts, where stimuli are manipulated to elicit specific emotional responses. However, for studies using more complex narratives with a less clear-cut position of shifts, other approaches are more appropriate. In this study, we are interested in the overall extent of valence shifts throughout the narrative rather than the intensity of a specific shift. Therefore, we use the intra-individual standard deviation of participants'

valence data as a variability measure (see recommendations on analyzing affective dynamics from experience sampling data by Ebner-Priemer et al., 2009).

The use of an RTR measure not only allows to investigate the link between transportation and valence shifts, but also to further examine the construct validity of a self-report measure of emotional flow[1] (Authors, under review). This scale was created to measure the overall experience of emotional flow throughout a narrative and is applicable to all research contexts and stimuli regardless of presentation mode (audiovisual, auditive, written text) or the particular emotional arc represented by the narrative (see Supplement S4 for the items). Valence shifts as a type of emotional shift should contribute to the overall perception of emotional flow.

Taken together, we expected a positive association between valence shifts and transportation (Hypothesis 1a) and a positive association between self-reported emotional flow and transportation (1b). We further expected a positive relationship between valence shifts and self-reported emotional flow (Hypothesis 2).

A secondary focus of our study was to examine possible gender differences in our measures of valence shifts and self-reported emotional flow. Prior research shows gender differences regarding the general self-reported frequency and intensity of certain emotions (e.g., Simon & Nath, 2004) as well as emotional responses to audiovisual media stimuli (e.g., Maffei et al., 2015). Given that women responded more strongly to emotional stimuli in prior research, we expected women to score higher than men both in valence shifts (Hypothesis 3a) and self-reported emotional flow (3b).

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[1] The order of Hypothesis 1 and 2 is reversed in the preregistration. Furthermore, our terminology slightly deviates from the preregistration. We now use the term *emotional flow* in reference to the construct underlying the self-report scale instead of *emotional shift*. The latter corresponded to the working title for the self-report scale at the time.

Methods

The preregistration of this article is available at https://aspredicted.org/5GN_7B8. This research was conducted in accordance with the Declaration of Helsinki and the ethical guidelines by the German Psychological Society (DGPs). Institutional approval is not required for psychological research in Germany, unless is relates to issues regulated by law. Informed consent was obtained from all participants before taking part in the study.

Sample and Design

The study followed a cross-sectional, non-experimental design. The sample size was determined a priori (see Supplement S1 for details). A total of 189 students of a German university participated for course credit. We excluded 18 participants due to technical malfunction of the RTR-slider, leading to missing values for one or both stimulus films. Another two participants were excluded due to insufficient language proficiency, leaving a final sample of 169 participants who were 22.59 years old on average ($SD = 6.83$) and predominantly female ($n = 110$).

Materials

Participants viewed excerpts from two films in randomized order. One excerpt was taken from *Head Full of Honey* (German: Honig im Kopf, Schweiger, 2014), a tragic comedy about a young girl and her grandfather, who suffers from dementia (clip duration 29:56 minutes). The second excerpt was taken from *My Sister's Keeper* (German: Beim Leben meiner Schwester, Cassavetes, 2009), a drama about a girl who serves as a savior sibling to cure her sister's leukemia (clip duration 33:38 minutes).

Measures

Valence Shifts

Emotional responses to the films were assessed using a continuous-response measure (1 Hz). Participants used a handheld device with a vertical slider to indicate emotional valence throughout the films on a continuum from positive (1023) to negative (0). A built-in linear

motor generated a resistance around the middle (480 to 522) to indicate the slider's neutral

position (501). Participants were instructed to use their dominant hand for operating the slider

(see Supplement S2 for the detailed instruction, and S6 for sample data). As an indicator of

the extent to which participants experienced valence shifts, we used the intra-individual

standard deviation (Ebner-Priemer et al., 2009). For this variable, higher values indicate

stronger valence shifts.

Self-Reported Emotional Flow

We used nine items (Authors, under review) to assess viewers' overall subjective

experience of emotional flow while watching the videos (e.g., "As I followed the story, I

experienced a series of different emotions", see Supplement S4). The items were presented

after each film and rated on 7-point rating scales ranging from 1 (not at all) to 7 (completely).

Cronbach's α was .89 for *Honey in the Head* and .93 for *My Sister's Keeper*.

Transportation

We measured transportation using the Transportation Scale-Short Form (6 items,

Appel et al., 2015) adapted to the context of audiovisual narratives (Gebbers et al., 2017;

Appel & Mengelkamp, 2022, e.g., "While watching the film clip, I had a vivid mental image

of the characters/the story setting"). Responses were measured on 7-point rating scales from 1

(not at all) to 7 (completely). Cronbach's α reached .79 for *Honey in the Head* and .82 for *My

Sister's Keeper.* Please see Supplement S5 for additional measures.

Procedure

Participants entered the laboratory individually or in groups of up to four. After being

instructed by a lab assistant, they first practiced operating the slider while watching a short

film (3 minutes). Then they read a summary of the first film's background story (see

Supplement S3) before watching the first film sequence, indicating their emotional responses

as they occurred with the slider. Immediately after the film had ended, participants completed

the self-report questionnaire that included the emotional flow and transportation items. The same procedure was repeated for the second film excerpt.

Results

Bayes-factor analyses were calculated using JASP version 0.16.1.0. The default JASP priors are used, i.e., a uniform prior for correlational analyses (Wagenmakers et al., 2018), and a Cauchy distribution for t-tests (Rouder et al., 2012).

Our first hypothesis stated a positive relationship between valence shifts and transportation, and between self-reported emotional flow and transportation. For both films, we observed significant and moderate to strong positive correlations between valence shifts and transportation, and between emotional flow and transportation. Bayes-factor analyses show that the data for the correlation between transportation and valence shifts is 1.13 million times (My Sister's Keeper) or 123,000 times (Head Full of Honey) more likely under the H_1 compared to the H_0, providing strong evidence that both variables are positively associated. For the correlation between transportation and emotional flow BF_{10} are even higher (Table 1). Thus, Hypotheses 1a and 1b are supported.

Furthermore, valence shifts were positively and significantly associated with self-reported emotional flow for both films. Bayes-factor analyses show that the data is 379,000 times (My Sister's Keeper) or 2.47 million times (Head full of Honey) more likely under the H_1 compared to the H_0, providing support for Hypothesis 2 (Table 1 and Supplement S9).

[Table 1]

To test for gender differences as predicted by Hypothesis 3, we conducted t-tests (one-tailed). Results show that indeed, women consistently reported higher emotional flow and

stronger valence shifts than men across both films (Table 2).[2] This is true for frequentist and

Bayesian analyses, which show that the data is at least 10.3 times more likely under the H_1

than the H_0. Thus, Hypothesis 3 is supported.

[Table 2]

Discussion

This study examined emotions as they occurred using RTR measurement to test

associations between valence shifts and post-exposure self-report measures of transportation

and emotional flow. Consistent with the postulations derived from Nabi and Green's (2015)

framework, the magnitude of valence shifts (operationalized as intraindividual RTR-variance)

was positively and substantially related to transportation and emotional flow. Using this type

of measure increases trust in our findings because the correlations are less likely to be affected

by common method bias (Podsakoff et al., 2003) and memory biases associated with

retrospective self-reports of emotion.

The relationship between valence shifts and emotional flow provides some further

evidence for the emotional flow self-report scale's construct validity. This scale was designed

to capture the general experience of emotional flow, regardless of the type of narrative and the

particular emotions involved. Because of the scale's versatility and ease of use it may prove

useful for future research, particularly in contexts in which process measures of emotion are

not viable. However, future studies are necessary to substantiate confidence in this scale's

construct validity, measurement invariance, and discriminant validity.

Our results indicate substantial gender differences with regard to valence shifts, self-

reported emotional flow, and transportation, such that women scored higher on these

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[2] Although not preregistered, we also tested for gender differences in transportation. Results were significant for both *Honey in the Head* (women: $M = 5.62$, $SD = 0.94$, men: $M = 5.02$, $SD = 0.96$), $t(167) = 3.92$, $p < .001$, $d = 0.63$, and *My Sister's Keeper* (women: $M = 5.46$, $SD = 0.85$, men: $M = 4.78$, $SD = 1.22$), $t(88.55) = 3.82$, $p < .001$, $d = 0.68$.

measures across both films. This ties in with previous studies, which found that women respond stronger to emotionally charged stimuli (e.g., Maffei, 2015). Moreover, research suggests that gender differences in emotional expression are influenced by gender roles (Chaplin, 2015), and that women report some negative emotions like sadness more frequently than men (e.g., Simon & Nath, 2004). The films used in this study both focused on tragic relational stories, which women may have responded to more strongly due to the communal theme of the films and their tragic appeal. Whether gender differences are present in response to other narratives is a question for future research. Furthermore, the subsample sizes in our study were unequal, owed to the fact that the examination of gender differences was a secondary goal. Future research is encouraged to corroborate our findings with more balanced subgroups.

The priority of this study was the measurement of valence shifts and establishing a link to transportation to provide a starting point for future research on the role of dynamic emotional experiences for narrative processing. Because our design does not include an experimental manipulation of valence shifts, the results presented here are correlational. Manipulating the experience of shifts is challenging, because altering the content of stories to achieve different emotional arcs may introduce confounding variables. We encourage future studies to further investigate the causal relationship between emotional shifts and other narrative processes by manipulating the experience of emotional shifts.

Another challenge for future studies is to investigate the dynamic relationship between transportation and emotional shifts at the intra-individual level. Because we used a static post-exposure measure of transportation, this was not possible in this study. However, previous research suggests that transportation is not static, but fluctuates throughout a narrative (e.g., Bezdek & Gerrig, 2017). To understand how emotional shifts foster transportation in the moment they occur (and in turn, if transportation enhances the experience of emotional shifts), future research should consider process measures of both experiences.

One limitation associated with RTR measures of emotion is that they are typically confined to one dimension (e.g., valence, Ruef & Levenson, 2007). Operating two sliders simultaneously increases the cognitive demand of the task (Lottridge & Chignell, 2010), which may interfere with other narrative processes. Thus, RTR measures are less suitable to capture shifts between discrete emotions. Furthermore, whenever participants experience positively and negatively valenced emotions simultaneously, they may have difficulty indicating their experience on one valence scale. Second, RTR measures are best suitable for auditive and audiovisual stimuli. For written narratives, other continuous measures of emotion are more appropriate, such as self-probed emotional retrospections, which are also suited to study subjectively experienced shifts between discrete emotions (Authors, in press).

Conclusion

Based on emotional shifts theory (Nabi & Green, 2015), we examined real-time valence shifts during two lengthy film excerpts. As expected, the magnitude of valence shifts (operationalized as intra-individual RTR-standard deviation) was associated with transportation and overall self-reported emotional flow. The method and results presented inform narrative theory and provide an inspiration to future research on the dynamic processing of stories.

Supplemental Material

The data, code, and supplemental material for this article are available at https://osf.io/8xuth/?view_only=2c01ea29577e445e99dfe9015ab5d6f0.

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Tables

Table 1

Means, Standard Deviations, and Zero-Order Correlations (p-Values, BF$_{10}$ in Brackets)

	Head Full of Honey		My Sister's Keeper				
	M	*SD*	*M*	*SD*	1	2	3
1. Valence shifts (RTR)	220.54	75.85	217.26	77.77	-	.432 ($< .001$, $2.47 \cdot 10^6$)	.396 ($< .001$, $1.23 \cdot 10^5$)
2. Emotional flow	5.52	1.02	5.06	1.22	.410 ($< .001$, $3.79 \cdot 10^5$)	-	.588 ($< .001$, $1.17 \cdot 10^{14}$)
3. Transportation	5.41	0.98	5.22	1.04	.423 ($< .001$, $1.13 \cdot 10^6$)	.603 ($< .001$, $1.51 \cdot 10^{15}$)	-

Note. Correlations above the diagonal for „Head full of Honey", below diagonal for „My Sister's Keeper". *N* = 169.

Table 2

Gender Differences in Valence Shifts and Self-Reported Emotional Flow

Variable	Women (n = 110)		Men (n = 59)		t	df	p	d	BF_{10}
	M	*SD*	*M*	*SD*					
Film excerpt from *Honey in the Head*									
Valence shifts	238.83	68.20	186.43	78.14	4.52	167	<. 001	0.73	2954.8
Emotional Flow	5.70	0.99	5.18	0.99	3.22	167	< .001	0.52	37.9
Film excerpt from *My Sister's Keeper*									
Valence shifts	232.19	72.78	189.41	79.72	3.52	167	<. 001	0.57	92.3
Emotional Flow	5.70	0.99	4.72	1.28	2.73	167	.003	0.44	10.3

Note. One-tailed t-tests.