Flow beim Lesen

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Gliederung

Zusammenfassung

Die vorliegende Dissertation befasst sich mit Flow-Zuständen beim Lesen fiktiver Texte. Das 1975 von Mihaly Csikszentmihalyi vorgestellte Konzept des *Flow* bezieht sich auf das völlige Aufgehen in einer optimal herausfordernden Tätigkeit, das mit Absorption, Verarbeitungsflüssigkeit und intrinsische Freude einhergeht. Bislang wurde Flow zumeist im Kontext motorischer und leistungsorientierter Aktivitäten empirisch untersucht und in erster Linie theoretisch mit Lesefreude in Verbindung gebracht. Ziel der drei Studien, die diese Dissertation umfasst, war es daher einerseits, Flow beim Lesen erstmals anhand größerer Leser-Stichproben und mithilfe von psychometrischen Gütekriterien genügenden Messinstrumenten nachzuweisen. Andererseits sollte Flow im Rahmen eines Modells für positives Leseerleben mit anderen in der Leseforschung diskutierten Konzepten in Verbindung gebracht und im Hinblick auf potenzielle psychophysiologische Korrelate untersucht werden.

In der ersten Studie wurde eine in der allgemeinen Flow-Forschung verbreitete Kurz-Skala an den Lesekontext adaptiert und anhand einer 229 Leser umfassenden Stichprobe psychometrisch getestet. Hierzu wurden die Teilnehmer im Rahmen einer Online-Studie gebeten, nach 20-minütigem Lesen in einem selbstgewählten Roman Fragebögen zu ihrem Leseerleben auszufüllen. Zufriedenstellende Reliabilitätskoeffizienten, positive Korrelationen mit konvergenten Maßen, die faktoranalytische Unterscheidbarkeit zu diskriminanten Maßen und die erwartete Assoziation mit einem Flow-Kriterium bestätigten die Güte der Flow-Skala. Eine Explorative Faktorenanalyse ergab jedoch, dass fast alle Items auf dem Faktor Absorption luden. Zudem ließ die zweifakorielle Skalenstruktur keine abschließende Aussage zur Legitimierung eines globalen Flow-Scores zu. Daher wurde in der zweiten Studie auf Basis der ersten Skala und der aus der Theorie bekannten Flow-Komponenten ein umfassenderer lesespezifischer Flow-Fragebogen entwickelt. Dessen Reliabilität und Validität konnte anhand einer Online-Studie mit 373 Teilnehmern, in deren Rahmen ein Kapitel

aus Homers *Odyssee* gelesen wurde, bestätigt werden. Neben Hinweisen zur konvergenten und diskriminanten Konstrukt- und zur Kriteriumsvalidität stützten die Ergebnisse einer Konfirmatorischen Faktorenanalyse eine theoretisch angemessene Skalenstruktur, mit den einzelnen Komponenten, mit Absorption, Verarbeitungsflüssigkeit und intrinsischer Freude als Subdimensionen und mit Flow als übergeordnetem Faktor. Mittels eines Strukturgleichungsmodells konnte zudem demonstriert werden, dass der auf Basis dieses Fragebogens gemessene Flow eine zentrale Rolle beim Leseerleben einnehmen kann. So wurde Flow als Mediator für andere, ebenfalls erhobene Erlebnisformen beim Lesen wie etwa Identifikation oder Spannung bestätigt. Von diesen Konzepten klärte Flow den größten Anteil an Varianz in Lesefreude und Textverständnis auf, die als Outcomes von positivem Leseerleben modelliert wurden. Da Flow gegenüber anderen Konzepten der Leseforschung den Vorteil hat, die Ableitung experimenteller Paradigmen und psychophysiologischer Hypothesen zu ermöglichen, wurden in der dritten Studie über die Manipulation des stilistischen Herausforderungsgrades eines weiteren *Odyssee*-Kapitels unterschiedliche Lese-Bedingungen hergestellt und kardiovaskuläre Daten gemessen. Es zeigten sich zwar keine signifikanten Gruppenunterschiede im Flow-Erleben, jedoch Interaktionen zwischen der Lesebedingung und kardiovaskulären Indikatoren bei der Vorhersage von Flow. So scheinen parasympathische Dominanz und ein entsprechender innerer Entspannungszustand, indiziert durch eine geringe Herzrate und hohe Herzratenvariabilität, Flow beim Lesen zu begünstigen, wenn der Text stilistisch anspruchsvoll ist. Es fanden sich hingegen keine Hinweise dafür, dass Flow-Erleben die Herzaktivität von Lesern verändert oder sich durch sie objektiv erfassen lässt.

Insgesamt sprechen die Ergebnisse dieses Forschungsprojektes somit für das Auftreten von Flow beim Lesen sowie für dessen zentrale Rolle bei positiven Leseerlebnissen. Außerdem zeigen sie das Potenzial des Flow-Konzeptes für die Leseforschung auf, insbesondere hinsichtlich psychophysiologischer Experimentalstudien.

Flow-Erleben beim Lesen literarischer Texte

Um sich der Faszination des Lesens, die in der deutschen Sprache durch Begriffe wie *Lesefreude* oder *Leselust* zum Ausdruck kommt, aus psychologischer Perspektive anzunähern, bedarf es einer wissenschaftlichen Auseinandersetzung mit dem inneren Erlebniszustand von Lesern. Dies ist für die Psychologie insbesondere aufgrund diverser positiver Effekte interessant, die Lesen mit sich bringen kann, sei es in Bezug auf Entspannung (Nell, 1988; Parlette & Howard, 2010), Stimmungsregulation (Knobloch, 2006; Zillmann, 1988), Verbesserung kognitiver Fähigkeiten (Berns, Blaine, Prietula, & Pye, 2013; Djikic, Oatley, Zoeterman, & Peterson, 2009; Vezzali, Stathi, Giovannini, Capozza, & Trifiletti, 2015) oder Verminderung in deren altersbedingtem Abbau (Bavishi, Slade, & Levy, 2016; Wilson et al., 2013). Lesefreude stellt nicht nur selbst einen positiven Leseeffekt dar, sondern auch einen Mediator für andere Wirkmechanismen des Lesens, da sie zur langfristigen Tätigkeitsausübung (Menninghaus et al., 2015) und zur eingehenden Beschäftigung mit dem Gelesenen (Moyer–Gusé, 2008) motiviert. Doch was bedingt den inneren Zustand der Lesefreude, wie lässt er sich konzeptuell erfassen und vorhersagen? Die Übertragung psychologischer Konzepte auf den Lesekontext könnte wesentlich zur Beantwortung dieser Fragen beitragen. Eines der am besten erforschten Konzepte zu intrinsischer Freude bei der Tätigkeitsausübung wurde 1975 von Mihaly Csikszentmihalyi vorgestellt: das sogenannte *Flow*-Erleben.

Flow und seine theoretischen Grundlagen

Bei Flow handelt es sich um einen spezifischen inneren Erlebniszustand, der sich auf das vollkommene Aufgehen in der Ausübung einer zielorientierten Aktivität bezieht (Csikszentmihalyi, 1975). Die im Hinblick auf intrinsisch motivierte Tätigkeitsausübung entwickelte Flow-Theorie besagt, dass ein Gleichgewicht zwischen dem Herausforderungsgrad der Aktivität und den Fähigkeiten der Person zu positivem Erleben in Form von Flow-Zuständen führt, was wiederum die Tätigkeit an sich lohnenswert erscheinen lässt. In Csikszentmihalyis

ursprünglichem *Flow-Modell* (1975) wird Flow von aversiven Langeweile- und Stresszuständen abgegrenzt, die durch Unter- oder Überforderung entstehen. Spätere Flow-Modelle (Csikszentmihalyi & LeFevre, 1989; Massimini & Carli, 1988) differenzieren die unterschiedlichen Zustände weiter aus, die aus verschiedenen Übereinstimmungsgraden von Anforderungen und Fähigkeiten resultieren; die zentrale Annahme, dass Flow durch deren optimale Balance entsteht, bleibt jedoch bestehen. Die Schlüsselrolle optimaler Herausforderung für Flow-Erleben konnte in korrelativen (Fullagar, Knight, & Sovern, 2013; Jackson & Marsh, 1996; Moneta & Csikszentmihalyi, 1996) und experimentellen Studien (Engeser & Rheinberg, 2008; Keller & Bless, 2008; Keller & Blomann, 2008) sowie Meta-Analysen (Fong, Zaleski, & Leach, 2015) empirisch belegt werden. Hierbei ist jedoch zu beachten, dass die subjektive Bewertung der Anforderungssituation (Nakamura & Csikszentmihalyi, 2009) ebenso wie individuelle und situative Faktoren diesen Wirkzusammenhang modulieren können. Auf Personenebene beeinflussen etwa Gewissenhaftigkeit (Demerouti, 2006), Kontrollüberzeugungen (Keller & Blomann, 2008), Handlungsorientierung (Keller & Bless, 2008) oder Selbstwirksamkeit (Jackson, Thomas, Marsh, & Smethurst, 2001; Rheinberg, Vollmeyer, & Engeser, 2003) die Entstehung von Flow, auf Situationsebene sind es etwa Leistungsdruck (Fullagar et al., 2013; Jackson, Ford, Kimiecik, & Marsh, 1998), Freiwilligkeit (Mannell, Zuzanek, & Larson, 1988) oder persönliche Bedeutung der Tätigkeit (Engeser & Rheinberg, 2008; Shernoff, Csikszentmihalyi, Schneider, & Shernoff, 2014).

Transfer des Flow-Modells auf den Lesekontext

Zur Übertragung der Flow-Theorie auf den Lesekontext (siehe Abbildung 1) müssen grundlegende Elemente wie Herausforderung, Fähigkeiten und Zielorientierung abstrahiert werden. So besteht die eigentliche Tätigkeit, bei der während des Lesens Flow entstehen kann, nicht im für die meisten Leser bereits stark überlernten Dekodieren von Buchstaben, sondern in der Konstruktion eines kohärenten mentalen Modells der Geschichte (Buselle &

Bilandzic, 2008). Hierbei werden Informationen aus dem Text durch die dynamische Aktivierung und Erweiterung kognitiver Schemata kontinuierlich in bereits vorhandenes Wissen integriert (Douglas & Hargadon, 2001). Ziel dieser Konstruktionsprozesse ist es, in die fiktive Welt der Geschichte einzutauchen, wobei es beim Leser liegt, selbstständig zielorientiert Interesse am Text zu entwickeln. Hierbei ergibt sich optimale Stimulierung – in diesem Zusammenhang der wohl anschaulichere Begriff als Herausforderung – aus einem komplexen Zusammenspiel von Texteigenschaften wie Inhalt, Erzählstruktur und Schreibstil einerseits und Leserfähigkeiten wie Vorwissen, Fantasie und Empathie andererseits (Sherry, 2004).

Abbildung 1. Flow-Modell im Lesekontext

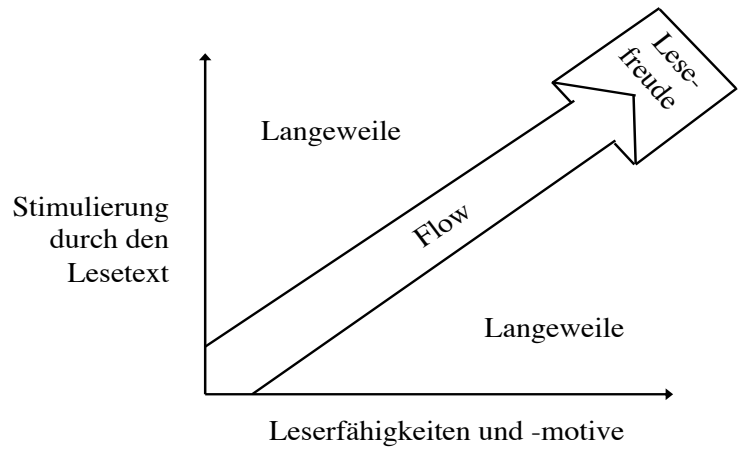

Abbildung 1. Adaption des ursprünglichen Flow-Modells nach Csikszentmihalyi (1975).

Verglichen mit leistungsbezogenen, physischen Aktivitäten, die traditionell im Fokus der Flow-Forschung stehen (Moneta & Csikszentmihalyi, 1996), ist Flow bei einer mentalen Aktivität wie dem Lesen demnach stärker über innere Empfindungen und selbstgesetzte Ziele zu konzeptualisieren. Obwohl der Lesekontext sich durch scheinbare Passivität von vielen typischen Flow-Aktivitäten abhebt (Rankin, Walsh, & Sweeny, 2018), ist das Flow-Modell auch auf Lesen transferierbar, indem ihm das Verständnis von Lesen als aktive, zielgerichtete Konstruktion mentaler Erzählungsmodelle zugrunde gelegt wird. Beim Lesen dürften Überforderungszustände jedoch kaum, wie im ursprünglichen Flow-Modell postuliert, Stresser-

leben auslösen, da Faktoren wie Kontrollverlust, negative soziale Bewertung und Verpflichtung in diesem Zusammenhang keine Rolle spielen (Tozman, Zhang, & Vollmeyer, 2017). Vielmehr sollte Flow beim Lesen primär mit Langeweile kontrastiert werden, da diese sowohl aus Unterforderung als auch aus Überforderung entstehen kann (Westgate & Wilson, 2018) und mit negativem Leseerleben assoziiert ist (Danckert, Hammerschmidt, Marty-Dugas, & Smilek, 2018; Merrifield & Danckert, 2014).

Experimentelle Paradigmen der Flow-Forschung und ihre Anwendung im Lesekontext

Da in der Leseforschung bislang hauptsächlich korrelative und quasi-experimentelle Ansätze verfolgt wurden (Willems & Jacobs, 2016), ist das Flow-Modell insofern von besonderem Interesse, als es die Ableitung experimenteller Paradigmen erlaubt (Moller, Meier, & Wall, 2010; Tozman & Peifer, 2016). In der experimentellen Flow-Forschung wird die Übereinstimmung von Anforderungen und Fähigkeiten als Vorbedingung für Flow gezielt herbeigeführt, indem ein mittleres Anforderungsniveau erstellt (Rheinberg et al., 2003), die Anforderung dynamisch an die Leistungen der Person angepasst (Keller & Blomann, 2008) oder der Anforderungsgrad mit dem vorher erfassten individuellen Leistungsgrad abgestimmt wird (Moller, Csikszentmihalyi, Nakamura, & Deci, 2007) . Als Kontrollbedingungen fungieren im Sinne des ursprünglichen Flow-Modells vergleichsweise leichte oder schwierige Anforderungen. Die Implementierung entsprechender Experimente im Lesekontext könnte durch die Manipulierung der Textanforderung über stilistische Merkmale, Erzählstruktur oder notwendiges Vorwissen realisiert werden. Während sowohl das dynamische Adaptieren eines Texts als auch dessen genaue Anpassung an den bei erwachsenen Lesern nur unzureichend mess- und operationalisierbaren Leistungsgrad kaum umsetzbar erscheinen, bieten sich stattdessen der Vergleich unterschiedlich anfordernder Texte sowie das Vorerfassen von Lesemotivation an. Da das Flow-Potenzial eines Lesetexts von vielen Faktoren abhängt, ist die Induktion von Flow beim Lesen im Experiment jedoch generell als herausfordernd zu betrachten.

Charakteristika des Flow-Zustands bei Lesern

Neben dem theoretischen Rahmen, den das Flow-Modell bietet, stützt sich die Flow-Forschung auf eine relativ klar ausdifferenzierte Konzeption des Zustands selbst, der sich über das gleichzeitige Auftreten einer Reihe von Bewusstseinsphänomenen definiert. Diese *Flow-Komponenten* können wie folgt beschrieben (Csikszentmihalyi, 1975; Jackson & Marsh, 1996) und in den Lesekontext eingeordnet werden:

1. *Verschmelzen von Tätigkeit und Bewusstsein*: Bewusste Denk- und Wahrnehmungsprozesse treten zugunsten einer automatisierten Tätigkeitsausübung in den Hintergrund. Ein Leser im Flow vertieft sich so stark in die Geschichte, dass es zum *Verschmelzen von fiktiver Welt und Bewusstsein* kommt.
2. *Fokussierung der Aufmerksamkeit:* Nicht mit der Aktivität in Zusammenhang stehende Stimuli einschließlich Umgebungsreize werden ausgeblendet. Beim Lesen im Flow ist der Leser voll und ganz auf die fiktive Welt der Geschichte konzentriert, sodass die reale Welt zeitweise aus seinem Bewusstsein heraustritt.
3. *Verlust des Ich-Bewusstseins*: Auf das Selbst und die Eigen- oder Fremdwahrnehmung bezogene innere Empfindungen verlieren an Relevanz. Im Lesekontext treten an deren Stelle Empfindungen in Bezug auf die Protagonisten der Geschichte.
4. *Verlust des Zeitgefühls*: Die subjektive Zeitwahrnehmung ist losgelöst von der tatsächlichen Dauer der Tätigkeitsausübung; im Flow vergisst der Leser die Zeit.
5. *Erhöhung des Kontrollempfindens*: Das Vertrauen in die eigene Leistung und die subjektive Kontrollüberzeugung wachsen. Während letzteres beim Lesen kaum eine Rolle spielen dürfte, kommt es stattdessen zur *Erhöhung des Kompetenzempfindens*.
6. *Wahrnehmung einer kohärenten Anforderungsstruktur:* Die Handlungsmöglichkeiten in der Aktivität erscheinen stringent und widerspruchsfrei. Unabhängig vom Stilmittel

der Narrativen Kohärenz empfindet der Leser den Text im Flow als stimmig und verständlich im Sinne der *Wahrnehmung einer kohärenten Erzählstruktur*.

7. *Klare Zielvorstellungen:* Die Zielstruktur der Tätigkeit wird intuitiv verinnerlicht. Die strukturgebende Funktion von Zielsetzungen wird beim Lesen im Flow von bestehenden kognitiven Schemata und deren Aktivierung durch den Text erfüllt, was zu subjektiv *Klaren Interpretationsmöglichkeiten* führt.
8. *Eindeutiges Verständnis aktivitätsbezogener Rückmeldungen*: Unmittelbare Rückschlüsse zwischen Aktion und Wirkung erlauben eine flüssige Handlungsabfolge. Beim Lesen im Flow werden Informationen aus dem Text unmittelbar mit dem mentalen Modell der Geschichte abgeglichen und als Feedback genutzt, sodass es zum *Eindeutigen Verständnis textbezogener Rückmeldungen* kommt.
9. *Intrinsische Motivation*: Die Aktivität wird als positiv und lohnenswert wahrgenommen, was im Lesekontext mit *Lesemotivation* gleichzusetzen ist.

Die verschiedenen Komponenten im Flow stehen in engem Zusammenhang (Jackson & Marsh, 1996) und in Interaktion (Quinn, 2005) miteinander, beziehen sich jedoch auf unterschiedliche latente Konstrukte (Engeser & Schiepe–Tiska, 2012). Im Wesentlichen lassen sich die Flow-Komponenten auf einen hohen Grad an *Absorption* einerseits und *flüssiger Verarbeitung* andererseits reduzieren (Rheinberg et al., 2003), was sich wiederum in einer empfundenen Anstrengungslosigkeit bei der Tätigkeit widerspiegelt. Zudem wird intrinsische Freude teils als weitere Dimension (Yoshida et al., 2013), teils als Bedingung (Mills & Fullagar, 2008) oder Resultat (Keller, Ringelhan, & Blomann, 2011) von Flow gedeutet.

Adaptierung von Flow-Fragebögen auf die Leseaktivität

Bei der psychometrischen Erfassung des Flow-Erlebens wird heutzutage größtenteils im Sinne des *komponentiellen Messansatzes* (Moneta, 2012) auf die Flow-Komponenten zurückgegriffen. Hierbei wird das Auftreten der einzelnen Komponenten unmittelbar nach der Tä-

tigkeitsausübung erfragt und über diese hinweg ein gemeinsamer Flow-Score gebildet (Jackson & Eklund, 2002; Rheinberg et al., 2003; Yoshida et al., 2013). Die faktorielle Struktur solcher Skalen spiegelt die theoretische Natur des Flow-Zustandes durch mehrfaktorielle Messmodelle höherer Ordnung mit einem übergeordneten Flow-Faktor wider (Beard & Hoy, 2010; Jackson & Eklund, 2002; Jackson & Marsh, 1996; Jackson, Martin, & Eklund, 2008). Zur validen Erfassung von Flow beim Lesen sollten die Items entsprechender Skalen genauso wie die Flow-Komponenten lesespezifisch adaptiert werden. Dies gilt insbesondere für auf mentale und nicht etwa auf motorische Prozesse bezogene Verarbeitungsflüssigkeits-Items.

Potenzielle psychophysiologische Korrelate von Flow beim Lesen

Aufgrund der indirekten, retrospektiven Natur von Fragebögen (Rich, 2013) und der Unzugänglichkeit von Flow-Erleben für direkte Introspektion (Peifer, 2012) finden in der Flow-Forschung momentan verstärkt Bemühungen statt, über psychophysiologische Maße einen direkteren Einblick in Flow-Zustände zu erlangen (für einen Überblick siehe Knierim, Rissler, Dorner, Maedche, & Weinhardt, 2018). Bisherige Erkenntnisse deuten darauf hin, dass Flow trotz subjektiver Leichtigkeit mit körperlicher und mentaler Anstrengung einhergeht (Keller, Bless, Blomann, & Kleinböhl, 2011), die jedoch anders als bei aversiv empfundenen Beanspruchungszuständen auf einem mittleren Niveau verbleibt (Peifer, 2012), von entspannenden Einflüssen moduliert wird (Ullén, De Manzano, Theorell, & Harmat, 2010) und mit positivem Affekt gekoppelt ist (De Manzano, Theorell, Harmat, & Ullén, 2010).

Im Kontext mentaler Aktivitäten wie Lesen bieten sich besonders kardiovaskuläre Maße zur Erfassung innerer Zustände an (Potter & Bolls, 2012). So besagt die *Neuroviszerale Integrationstheorie* (Thayer, Hansen, Saus–Rose, & Johnson, 2009), dass kognitive Leistungen durch Vagotonie, also durch die Dominanz des Parasympathischen gegenüber dem Sympathischen Nervensystem, begünstigt werden. Der Parasympathikus repräsentiert jenen Teil des Vegetativen Nervensystems, der innerkörperliche Funktionen in Ruhephasen regu-

liert, darunter auch die Herzaktivität. Über den Vagusnerv, einen der Hauptnerven des Parasympathikus, werden präfrontale Hirnprozesse mit der Herzaktivität in Zusammenspiel gebracht. Kardiale Vagotonie schlägt sich sowohl in der Herzrate (HR), durch eine Verringerung der Herzschläge pro Minute, als auch in der Herzratenvariabilität (HRV), über stärkere Veränderungen im Herzrhythmus, nieder (Berntson, Quigley, Norman, & Lozano, 2016; Potter & Bolls, 2012). Hierdurch werden eine effizientere Energiezuteilung (Grossman & Taylor, 2007) und Enkodierung von Umweltreizen (Graham & Clifton, 1966; Park & Thayer, 2014) ermöglicht, was wiederum zu einer Verbesserung in deren kognitiver Verarbeitung führt (Thayer & Lane, 2009). Da die Herzaktivität sich auf diese Weise auch auf die Verarbeitung von medialen Inhalten auswirkt (Lang, 2014; Wise, Bolls, Myers, & Sternadori, 2009), erscheint eine Assoziation zwischen Flow beim Lesen und kardialer Vagotonie als psychophysiologische Grundlage für die erhöhte Verarbeitungsflüssigkeit bei der Konstruktion mentaler Erzählungsmodelle plausibel. In anderen Aktivitätskontexten gesammelte kardiovaskuläre Befunde sprechen zum Teil für (Drachen, Nacke, Yannakakis, & Pedersen, 2010; Léger, Davis, Cronan, & Perret, 2014; Peifer, Schächinger, Engeser, & Antoni, 2015; Tozman, Magdas, MacDougall, & Vollmeyer, 2015), jedoch zum Teil auch gegen eine solche Assoziation von Flow und kardialer Vagotonie (Bian et al., 2016; De Manzano et al., 2010; Gaggioli, Cipresso, Serino, & Riva, 2013; Keller et al., 2011).

Flow und andere Erlebnisformen beim Lesen

Zwar wurde Flow in der theoretischen Diskussion von Lesefreude bereits wiederholt aufgegriffen (Buselle & Bilandzic, 2008; Muth, 1996; Weber, Tamborini, Westcott-Baker, & Kantor, 2009), bislang stehen jedoch Konzepte wie *Presence*, *Identifikation*, *Spannung* und *Kognitive Involvierung* im Fokus der Leseforschung. Presence (Gerrig, 1993; Lee, 2004) ist der aus der virtuellen Realitätsforschung bekannten *Immersion* (Murray, 1997) und der konzeptuell stärker prozessorientierten *Transportation* (Green & Brock, 2000) verwandt und be-

zieht sich auf den subjektiven Eindruck, in die fiktive Welt der Geschichte hineinversetzt zu sein. Bei Identifikation geht es hingegen darum, sich in eine fiktive Figur hineinzuversetzen und deren Perspektive zu verinnerlichen (Cohen, 2001; Tal–Or & Cohen, 2010). Spannung wiederum bezeichnet den inneren Erregungszustand, der in Folge von Antizipationen über Verlauf oder Ende einer Geschichte entsteht, insbesondere wenn eine emotionale Verbindung zu den Figuren existiert (Brewer & Lichtenstein, 1982; Hoeken & van Vliet, 2000; Zillmann, 1996). Bei Kognitiver Involvierung schließlich geht es um ein bewusstes Nachdenken über den Text, bei dem Bezüge zu Weltwissen, eigenen Erinnerungen und externen Informationsquellen hergestellt werden (Appel, Koch, Schreier, & Groeben, 2002; Kim & Rubin, 1997).

Alle aufgeführten Konzepte stehen mit Lesefreude in Zusammenhang, da sie die emotionale und kognitive Anbindung (Appel et al., 2002; Green, Brock, & Kaufman, 2004; Tal–Or & Cohen, 2010), die Stimmung (Zillmann, 1988; Zuckerman, 1971) und die meta-emotionale Bewertung (Bartsch & Viehoff, 2010) des Lesers positiv beeinflussen können. Zudem beruhen sie alle auf einer optimalen Kumulierung kognitiver, imaginärer und empathischer Prozesse beim Lesen, wodurch wiederum ein Bezug zu Flow gegeben ist. Aus der allgemeinen Flow-Forschung ist bekannt, dass Flow nicht nur mit gesteigerter Motivation (Keller et al., 2011; Lee, 2005) und positivem Affekt (Rogatko, 2009; Schüler, 2007) einhergeht, sondern auch mit Leistungsverbesserungen (Engeser & Rheinberg, 2008; Privette & Brundrick, 1991). Daher erscheint es plausibel, dass Leser im Flow sowohl engagierter bei der Konstruktion eines mentalen Erzählungsmodells sind als auch komplexere und plastischere mentale Repräsentationen von Figuren, Szenen und Erzählsträngen entwickeln. So könnte Flow eine Schlüsselrolle bei der Entstehung textspezifischer Erlebensformen einnehmen, indem mit der Konstruktion eines elaborierten mentalen Modells der Geschichte die Grundlage für ein intensives, multidimensionales Leseerlebnis gelegt wird.

Der Vorteil der Integration von Flow in multidimensionale Modelle für Leseerleben, wie sie in der neueren Leseforschung verstärkt diskutiert werden (Buselle & Bilandzic, 2008; Hamby, Brinberg, & Jaccard, 2016; Jacobs, 2015), liegt nicht nur in der Anbindung an die Psychologie, sondern auch in der Übertragung eines theoretischen Rahmens auf ein Forschungsfeld, das bislang von einer Vielzahl schwer dissoziierbarer und teilweise unzureichend definierter Konzepte geprägt ist (Buselle & Bilandzic, 2009; Tal–Or & Cohen, 2010). Flow wurde bisher nur vereinzelt mit Konzepten der Leseforschung in Zusammenhang gebracht, beispielsweise mit Presence (Buselle & Bilandzic, 2009) oder Transportation (Green et al., 2004) aufgrund von Gemeinsamkeiten wie dem Verlust des Ich-Bewusstseins. Eine umfassende theoretische Anbindung von Lese-Konzepten an das Flow-Modell und die Flow-Komponenten steht hingegen noch aus, ebenso wie ein empirischer Vergleich.

Bisherige empirische Befunde zu Flow beim Lesen

Flow-Zustände bei Lesern wurden bislang kaum empirisch untersucht und die Studien, die bisher hierzu veröffentlicht wurden, sind insofern kritisch zu betrachten, als dass Flow nicht unmittelbar nach dem Lesen (Massimini, Csikszentmihalyi, & Delle Fave, 1988; McQuilian & Conde, 1996; Rankin et al., 2018), nicht unter Berücksichtigung aller Flow-Komponenten (Massimini et al., 1988; McQuilian & Conde, 1996; Rankin et al., 2018) oder nicht mit zum Lesekontext passenden Items gemessen wurde (Ghonsooly & Hamedi, 2014; Shahian, Pishghadam, & Khajavy, 2017). Dennoch liefern Umfragen zu Flow im Alltagserleben (Massimini et al., 1988; Rankin et al., 2018), Interviews mit lesebegeisterten Personen (McQuilian & Conde, 1996) und hohe Flow-Scores in Leser-Stichproben (Ghonsooly & Hamedi, 2014; McQuilian & Conde, 1996; Shahian et al., 2017) erste Hinweise, dass Lesen häufig mit Flow-Erleben assoziiert ist, vor allem das Lesen fiktiver Texte im Freizeitkontext (McQuilian & Conde, 1996). Faktoren auf Seiten des Lesers wie Vorwissen und Vorinteresse, Texteigenschaften wie ein deskriptiver Erzählstil und Aspekte der Lesesituation wie

Selbstbestimmtheit bei der Textauswahl scheinen hierfür bedeutsam zu sein (Ghonsooly & Hamedi, 2014; McQuilian & Conde, 1996; Shahian et al., 2017). Zudem geht Flow beim Lesen offenbar mit tieferem Textverständnis (Shahian et al., 2017) sowie mit persönlichem und intellektuellem Gefallen am Text (McQuilian & Conde, 1996) einher.

Studien zu Flow beim Lesen[1]

Forschungsfragen

Um die Erforschung von Flow-Zuständen beim Lesen weiter voranzutreiben, bedarf es vor allem einer validen, lesespezifischen Flow-Skala (Studie 1), eines Modells zum Zusammenspiel von Flow mit anderen Erlebnisformen beim Lesen (Studie 2) sowie der Erprobung der Flow-Theorie im Hinblick auf psychophysiologische Hypothesen und experimentelle Paradigmen im Lesekontext (Studie 3). In Studie 1 sollte die Hypothese getestet werden, dass Flow-Zustände beim Lesen auftreten können, indem sie erstmals auf Basis eines großen Lesersamples und gemäß psychometrischer Standards erfasst wurden. Studie 2 diente der Prüfung der Hypothese, dass Flow eine Schlüsselrolle im multidimensionalen positiven Leseerleben einnimmt, wozu die Interaktion von Flow mit textspezifischen Erlebnisformen modelliert und getestet wurde. Anhand von Studie 3 sollte demonstriert werden, dass sich psychophysiologische Hypothesen zu Flow im Lesekontext experimentell testen lassen, am Beispiel der Hypothese, dass Flow beim Lesen mit kardialer Vagotonie einhergeht.

Studie 1: Lesespezifische Flow-Erfassung

In der ersten Studie ging es darum, durch die Adaptierung eines in der allgemeinen Flow-Forschung etablierten Fragebogens an den Lesekontext ein lesespezifisches Flow-Maß zu entwickeln und psychometrisch zu testen, um das Auftreten von Flow bei Lesern empirisch

[1] Alle in den nachfolgend beschriebenen Studien angewandten Methoden wurden vom Ethikrat der Max-Planck-Gesellschaft bewilligt und die informierte Einwilligung aller Studienteilnehmer wurde vorab eingeholt. Teilnahmeanreize umfassten die Verlosung von 70 Buchgutscheinen im Wert von je 20€ in Studie 1, die Vergabe von Buchgutscheinen im Wert von je 12€ in Studie 2 und eine Vergütung in Höhe von 30€ in bar in Studie 3. Zur statistischen Datenauswertung wurde die Computer-Software R und für die Verarbeitung psychophysiologischer Daten die Computer-Software MatLab eingesetzt.

belegen zu können. Ausgangspunkt für die Skalenentwicklung war die im deutschsprachigen Raum weit verbreitete Flow-Kurzskala (FKS) von Rheinberg und Kollegen (2003). Die FKS erfasst Flow über die Faktoren *Absorbiertheit* und *Glatter automatisierter Verlauf* mithilfe von 10 Items, die unmittelbar nach der Tätigkeitsausübung auf einer siebenstufigen Likert-Skala zu beantworten sind und über die hinweg ein Flow-Gesamtscore gebildet wird. Drei komplementäre Items erfassen die *Passung* zwischen Fähigkeiten und Anforderungen, deren Optimum durch den Mittelpunkt der Antwortskala indiziert wird. Weitere Items zur Messung von *Besorgnis* als Gegenpol zu Flow wurden aufgrund der fehlenden sozialen Bewertungssituation im Lesekontext nicht in die lesespezifische Skalenversion übernommen.

Zur Erstellung des lesespezifischen Flow-Fragebogens, der Reading Flow Short Scale (RFSS), wurden die Absorptions- sowie zwei der Passungs-Items so adaptiert, dass die Aktivität Lesen konkret benannt wird. Die Verarbeitungsflüssigkeits-Items wurden hingegen in Rücksprache mit einem der FKS-Autoren teils stark umformuliert, um sie sinngemäß an den Lesekontext anzupassen. Anhand einer Online-Umfrage mit $N = 229$ Lesern wurde die RFSS psychometrisch erprobt, indem ihre Faktorstruktur, die Vorhersagbarkeit ihres Flow-Scores durch die subjektive Passung von Anforderungen und Fähigkeiten sowie ihre Beziehung zu konvergenten und diskriminanten Maßen getestet wurden. Um die Auftretenswahrscheinlichkeit von Flow im Rahmen der Studie zu erhöhen, wurde hierzu auf eine selbstselektierte Stichprobe leseaffiner Personen zurückgegriffen, die gerade den zweiten Teil eines selbstgewählten, ihnen zuvor unbekannten und ihnen sprachlich verständlichen Romans las.

In der Online-Studie wurden die Teilnehmer ($M = 35$ Jahre, $SD = 15$ Jahre; 79% Frauen) gebeten, weitere 20 Minuten im Roman zu lesen und danach Fragebögen zum Leseerleben zu beantworten. Während Flow mittels der RFSS gemessen wurde, kamen anhand längerer oder verwandter Skalen entwickelte Ad-hoc-Maße zur Erfassung von Presence, Identifikation, Spannung und kognitiver Involvierung (hier cognitive mastery genannt) zum Einsatz. Diese

wurden mit dem Ziel verwendet, die betreffenden Konzepte möglichst genau, ohne inhaltliche Überschneidung zu messen. Darüber hinaus erfragten einzelne Items Lesefreude, generelle Leseaffinität und habituelle Lesehäufigkeit sowie die Motivation, im Roman weiterzulesen oder einen weiteren, ähnlichen Roman zu lesen. Zudem füllten die Teilnehmer eine vier Items umfassende, auf Basis entsprechender allgemeiner Maße entwickelte lesespezifische Selbstwirksamkeits-Skala aus. Die konvergenten Maße wurden ergänzt durch eine schriftliche Definition von Flow beim Lesen, anhand derer die Teilnehmer am Ende der Befragung einschätzen sollten, inwieweit sie beim Lesen generell zu Flow neigen.

Wegen des neuen Anwendungskontexts und der zum Teil substanziellen Umformulierung der Skala wurden die RFSS-Items zunächst einer Explorativen Faktorenanalyse (EFA) unterzogen. Basierend auf Maximum-Likelihood-Schätzung und, aufgrund der Nicht-Normalverteilung der Daten, einer polychorischen Korrelationsmatrix wurden mittels Hauptkomponentenanalyse mit obliquer Geomin-Rotation zwei Faktoren extrahiert, mit denen 45% der Varianz aufklärt werden konnte. Während sich bei dieser durch Parallelanalyse, Velicer's MAP Test und Screeplots nahegelegten zweifaktoriellen Lösung acht Items klar den Faktoren *Absorption* und *Verarbeitungsflüssigkeit* zuordnen ließen, zeigten sich für die Items 4 und 5 Querladung, aufgrund derer sie von der RFSS entfernt wurden. Da die verbliebenen Items eine hohe interne Konsistenz und beide RFSS-Faktoren eine mittlere Korrelation aufwiesen, wurde wie bei der FKS auch ein Flow-Gesamtscore gebildet. Dieser zeigte die theoretisch anzunehmenden Assoziationen mit den erhobenen konvergenten Maßen in Form von signifikant positiven Korrelationen und ließ sich, wie auf Basis der Flow-Theorie zu erwarten, anhand des Verhältnisses von Anforderungen und Fähigkeiten vorhersagen. So offenbarten ordinale Regressionsanalysen einen umgekehrt U-förmigen Zusammenhang, mit den höchsten Flow-Werten bei optimaler Passung. Neben diesen Hinweisen auf die konvergente Konstrukt- und die Kriteriumsvalidität der RFSS konnte deren diskriminante Konstruktvalidität

mittels Modellvergleichen zwischen einfaktoriellen und multifaktoriellen Konfirmatorischen Faktorenanalysemodellen (CFA-Modellen) für Flow gepaart jeweils mit Presence, Identifikation, Spannung oder Kognitiver Involvierung nachgewiesen werden: Die für ordinale Daten anhand des robusten WLSMV-Schätzers modellierten Faktor-Lösungen ergaben eine signifikant bessere Passung zu den beobachteten Daten für die mehrfaktoriellen Modelle, in denen Flow einen vom jeweils anderen Konzept unterscheidbaren, eigenen Faktor bildete.

Insgesamt wurde somit erste Evidenz für eine reliable und valide Flow-Messung durch die RFSS gesammelt. Die im Mittel hohen Flow-Werte, die auf der RFSS erzielt wurden, wiederum stützen die Hypothese, dass Flow-Zustände beim Lesen auftreten. Demnach erscheint es weiterhin sinnvoll, das Flow-Konzept in die Erforschung von Lesefreude zu integrieren und die Flow-Forschung auf mentale Aktivitäten wie Lesen auszuweiten.

Studie 2: Multidimensionales Modell zum Leseerleben mit Flow

Um das Flow-Konzept in die Leseforschung einzugliedern, sollte in der zweiten Studie die Rolle von Flow bei positivem Leseerleben im Zusammenspiel mit Presence, Identifikation, Spannung und Kognitiver Involvierung untersucht werden. Diese verschiedenen, bislang weitestgehend separat betrachteten Facetten des Leseerlebens wurden im Rahmen einer Online-Studie bei $N = 373$ Lesern ($M = 36$ Jahre, $SD = 15$ Jahre; 65% Frauen) unmittelbar nach dem Lesen eines Kapitels aus einer modernen Prosaübersetzung von Homers *Odyssee* (Lempp, 2010) gemessen. Der Text wurde in Rücksprache mit Literaturwissenschaftlern gewählt und die Stichprobe aus selbstselektierten, leseaffinen Personen rekrutiert, um die Wahrscheinlichkeit von Lesefreude und der damit verbundenen Erlebnisformen zu erhöhen.

Zur Messung von Presence, Identifikation, Spannung und Kognitiver Involvierung kamen entsprechende Subskalen des Leseerlebens-Fragebogens von Appel und Kollegen (2002) zum Einsatz, während zur Flow-Messung auf Basis der oben vorgestellten RFSS eine längere, umfassendere Skala, die Fiction Reading Flow Scale (FRFS), entwickelt wurde. Grund hierfür

war das Bestreben, Flow beim Lesen möglichst genau und mit allen seinen Komponenten zu messen, in Anlehnung an längere Flow-Fragebögen (Jackson & Marsh, 1996) und an den vorherrschenden Messansatz (Moneta, 2012) in der allgemeinen Flow-Forschung. Daher wurden für die FRFS 27 Items erstellt, von denen je drei eine der neun Flow-Komponenten in ihrer lesespezifischen Form auf einer siebenstufigen Likert-Skala erfassen. Zusätzlich zur FRFS und den Leseerlebens-Skalen beantworteten die Teilnehmer Fragen zu ihrer generellen Leseaffinität, -häufigkeit und -selbstwirksamkeit sowie zu Lesemotivation, Vorwissen, Lesefreude und wahrgenommener Passung von Textanforderungen und eigenen Leserfähigkeiten in Bezug auf das *Odyssee*-Kapitel. Zur Messung der generellen Leserfähigkeiten kam zudem der für die Online-Darbietung adaptierte Lesegeschwindigkeits- und Verständnistest (LGVT) von Schneider, Schlagmüller und Ennemoser (2017) zum Einsatz, ein auf einem Lückentext beruhender Speed-Test zu sinnerfassendem Lesen. Das Textverständnis im Hinblick auf den konkreten Lesetext wurde anhand von Multiple-Choice-Fragen gemessen, deren korrekte Beantwortung Interpretations- und Inferenztätigkeit von Seiten des Lesers erforderte.

Um die psychometrische Eignung der FRFS zu überprüfen, wurde zunächst ein CFA-Modell mit der folgenden, aus der Theorie zur komponentiellen Flow-Messung abgeleiteten Faktorstruktur erstellt: neun Faktoren 1. Ordnung für die neun dem Flow-Erleben zugrunde liegenden Komponenten, drei Faktoren 2. Ordnung für die übergeordneten Flow-Dimensionen *Absorption*, *Verarbeitungsflüssigkeit* und *Freude am Tun* und ein Faktor 3. Ordnung für den Flow-Zustand selbst. Das aufgrund von Nicht-Normalverteilung mittels einer polychorischen Korrelationsmatrix und des robusten WLSMV-Schätzers implementierte Modell ergab eine gute Passung zu den beobachteten Daten, was als Hinweis zur Skalenvalidität gewertet werden kann. Weitere Evidenz diesbezüglich erbrachten positive Korrelationen des FRFS-Flow-Scores mit konvergenten Maßen für Lesefreude, -motivation, -affinität und -häufigkeit sowie zu lesebezogener Selbstwirksamkeit, Textverständnis und LGVT-Lesegenauigkeit. Zudem

bestätigten die Ergebnisse einer ordinalen Regressionsanalyse den zu erwartenden, umgekehrt U-förmigen Zusammenhang zwischen Flow und Passung von Anforderungen und Fähigkeiten. Auch die Reliabilität der FRFS war sowohl auf Gesamt- als auch auf Subskalenniveau als gut zu bewerten.

Nach der psychometrischen Testung der FRFS wurde basierend auf dem FRFS-Flow-Score das Verhältnis von Flow zu Presence, Identifikation, Spannung und Kognitiver Involvierung beim Lesen anhand von Korrelationen und mittels eines alle Konzepte umfassenden, mehrfaktoriellen CFA-Modells untersucht. Hierdurch zeigten sich einerseits hohe positive Zusammenhänge zwischen den Lesekonzepten und andererseits deren faktoranalytische Unterscheidbarkeit. Um das Zusammenspiel der unterschiedlichen Konzepte beim Leseerleben zu prüfen, wurde ein Strukturgleichungsmodell (SEM) für ordinale Indikatoren erstellt, wobei das Messmodell entsprechend der oben ausgeführten Faktorenstruktur der FRFS und einfaktorieller Strukturen für die übrigen Konzepte spezifiziert wurde. In das Strukturmodell gingen Lesemotivation und Leserfähigkeit als exogene sowie Lesefreude und Textverständnis als endogene Variablen ein, während Flow, Presence, Identifikation, Spannung und Kognitive Involvierung als Variablen im Leseprozess moduliert und Bildungsgrad und Vorwissen zum Text als Kovariaten eingefügt wurden. Das SEM wurde zunächst hypothesengeleitet spezifiziert, dann empirisch getestet und anschließend um nichtsignifikante Pfade reduziert.

Auf der Grundlage des robusten WLSMV-Schätzers ergab das finale Modell eine gute Übereinstimmung mit den Daten. Die SEM-Ergebnisse bestätigten die zentrale Rolle von Flow im Leseerleben insofern, als Presence und Identifikation direkt, Spannung sowohl direkt als auch indirekt und Kognitive Involvierung indirekt in statistisch bedeutsamem Maße durch Flow-Erleben verstärkt wurden. Zudem klärte Flow von allen erfassten Erlebnisformen beim Lesen die meiste Varianz in Lesefreude und Textverständnis auf. Mittels gezielter Herausnahme von Pfaden konnte Flow darüber hinaus als negativer Suppressor (Darlington,

1968) für positiv mit den Outcomes assoziierte Varianz in anderen Erlebnisformen identifiziert werden. Beispielsweise kovariierte Presence beim Lesen des *Odyssee*-Kapitels, das gruselige, gewalttätige Szenen enthält, teilweise negativ mit Lesefreude; wurden aber über Herausnahme des Pfades zwischen Flow und Lesefreude gemeinsame Varianzanteile von Flow und Presence allein über Presence modelliert, verkehrte sich diese Assoziation ins Positive.

Insgesamt bestätigten die Studienergebnisse somit die Hypothese, dass Lesen als multidimensionales Erlebnis konzeptualisiert werden kann, in dem Flow im Sinne eines Katalysators für andere, textspezifische Erlebnisformen eine entscheidende Rolle spielt. Flow hat hierbei offenbar selbst eine durchweg positive Wirkung und unterstützt zudem die positive Wirkung anderer, je nach Text ambivalenterer Erlebnisformen beim Lesen.

Studie 3: Kardiovaskuläre Korrelate von Flow beim Lesen

Ziel der dritten Studie war es, Flow-Zustände beim Lesen psychophysiologisch zu untersuchen und das Potenzial des Flow-Konzepts für die experimentelle Leseforschung aufzuzeigen. Hierzu wurden während des Lesens kardiovaskuläre Daten erhoben, da kardiale Vagotonie mit kognitiver Verarbeitungsflüssigkeit (Thayer et al., 2009; Thayer & Lane, 2009) und somit theoretisch auch mit Flow beim Lesen assoziiert ist. Zur Entwicklung eines experimentellen Paradigmas wurden die aus der allgemeinen Flow-Forschung bekannten Möglichkeiten genutzt, Flow-Erleben über das Anforderungsniveau zu beeinflussen (Rheinberg et al., 2003) und das individuelle Flow-Potenzial einer Anforderungssituation durch Vortests zu approximieren (Moller et al., 2007). Vor diesem Hintergrund wurden diejenigen Teilnehmer der oben beschriebenen zweiten Studie rekrutiert, die überdurchschnittliches Flow-Erleben beim Lesen eines *Odyssee*-Kapitels aufgewiesen hatten, und drei unterschiedlich anspruchsvoll geschriebene Versionen eines weiteren *Odyssee*-Kapitels als Lesetext verwendet. Hierbei wurde in Absprache mit literaturwissenschaftlichen Experten auf eine ältere Übersetzung (Schadewaldt, 1958), eine moderne Übersetzung (Lempp, 2010) und eine vereinfachte Abwandlung

der modernen Übersetzung zurückgegriffen, die sich jeweils in ihrer Lesbarkeit, quantifiziert über das computerlinguistische Konzept der *Readability* (Klare, 1963), unterschieden.

Jedem der insgesamt 94 Teilnehmer wurde randomisiert eine Version des *Odyssee*-Kapitels präsentiert. Um die Lesesituation möglichst realistisch zu gestalten, durchliefen die Teilnehmer das Experiment in Einzeltestung in einem wie ein Wohnzimmer eingerichteten Laborraum und erhielten den Textstimulus in Buchform. Mittels mobiler Elektrokardiographie wurden kardiovaskuläre Daten sowohl während einer 10-minütigen Entspannungs-Baseline als auch beim Lesen aufgezeichnet. Zudem wurden Selbstauskünfte in Bezug auf möglicherweise für das Leseerleben relevante Lesercharakteristika eingeholt, darunter ästhetische Empfänglichkeit mithilfe des Aesthetic Responsiveness and Engagement Assessment (AREA; Schlotz, Wallot, Omigie, Masucci, & Vessel, 2019) und Langeweile-Neigung mithilfe der Short Boredom Proneness Scale (SBPS; Struk, Carriere, Cheyne, & Danckert, 2017). Unmittelbar nach dem Lesen wurden die Teilnehmer gebeten, die FRFS zur Flow-Messung sowie Einzelitems zum subjektiven Über- oder Unterforderungserleben zu beantworten.

In die Datenanalyse gingen aufgrund technischer Probleme Datensätze von $N = 84$ Teilnehmern ($M = 35$, $SD = 16$; 57% Frauen) ein. In Bezug auf die in der zweiten Studie erhobenen Hintergrundvariablen und die Angaben zu Lesercharakteristika konnte eine erfolgreiche Randomisierung auf die drei experimentellen Bedingungen ($n = 29$; $n = 31$; $n = 24$) anhand von nichtsignifikanten Kruskal-Wallis-Tests bestätigt werden. Das Auftreten von Gruppenunterschieden im Unterforderungs-, Überforderungs- und Flow-Erleben wurde mittels weiterer Kruskal-Wallis-Tests und einer Varianzanalyse nachgewiesen. Während das Antwortmuster in Bezug auf Unter- und Überforderungserleben beim Lesen der Manipulation der stilistischen Anforderungen entsprach, lagen die Flow-Scores in allen Bedingungen über dem Skalenmittelpunkt und wiesen in Post-Hoc-Tests keine signifikanten Unterschiede auf. Somit wurde durch die Studie einerseits ein erster Beweis erbracht, dass sich Flow beim

Lesen unter Laborbedingungen gezielt induzieren lässt. Andererseits scheint die Manipulation von stilistischen Textanforderungen hierzu, wenn auch praktisch gut durchführbar, nur begrenzt wirksam, da zumindest bei motivierten Lesern und bei einem inhaltlich ansprechenden Text keine signifikanten Gruppenunterschiede im Flow-Erleben zu beobachten waren.

Aus den kardiovaskulären Daten wurden für jeden Teilnehmer die Herzrate (HR) sowie die Herzratenvariabilität (HRV), gemessen als Root Mean Squares of Successive Differences (RMSSD), jeweils über die Lesephase und über die Entspannungs-Baseline hinweg aggregiert. Hierfür wurde das Signal transformiert, in Entspannungs- und Lesephase editiert, mittels Filtern von Artefakten befreit und Algorithmen zur Detektierung von Herzschlägen sowie einer Analyse der Abstände zwischen aufeinanderfolgenden Herzschlägen im Zeitbereich unterzogen (Afonso, Tompkins, Nguyen, & Luo, 1999; Cacioppo, Tassinary, & Berntson, 2007; Piskorski & Guzik, 2005). Die mittlere HR und RMSSD beim Lesen gingen jeweils als Prädiktoren für das subjektive Flow-Empfinden in lineare Regressionsanalysen ein, nachdem die Regressionsvoraussetzungen überprüft worden waren. In einem zweiten Schritt wurden die experimentelle Bedingung und damit der stilistische Anforderungsgrad des Textes sowie dessen Interaktion mit HR oder RMSSD in die Modelle aufgenommen. Im dritten und letzten Schritt wurden Change-Scores anstelle der über die Lesephase aggregierten HR und RMSSD als Prädiktoren in die Regressionsmodelle eingefügt, um für die kardiovaskuläre Baseline zu kontrollieren. Hierbei handelte es sich jeweils um die Differenz zwischen der individuellen mittleren HR oder RMSSD beim Lesen und dem entsprechenden Wert in der Entspannung.

Übereinstimmend mit der theoretisch angenommenen Assoziation zwischen kardialer Vagotonie und Flow zeigten sich ein negativer Zusammenhang zwischen Flow und mittlerer HR beim Lesen sowie ein positiver Zusammenhang zwischen Flow und RMSSD während des Lesens. In den Modellen, in denen der stilistische Anforderungsgrad des Textes bei der Vorhersage von Flow berücksichtigt wurde, ergaben sich neben signifikanten Haupteffekten auch

jeweils signifikante Interaktionen. Diese Effekte verschwanden jedoch, wenn die Change-Scores als Prädiktoren verwendet, also Unterschiede in der Baseline kontrolliert wurden.

Insgesamt scheint kardiale Vagotonie, also eine Dominanz des mit Entspannung verbundenen parasympathischen Nervensystems, somit mit Flow-Zuständen beim Lesen einherzugehen. Dieser Effekt wird jedoch durch den stilistischen Anforderungsgrad des Textes moderiert und zeigt sich in statistisch bedeutsamem Maße nur bei mittelhohen bis hohen Anforderungen an den Leser. Zudem bleibt der Effekt nicht bestehen, wenn die individuelle kardiovaskuläre Baseline berücksichtigt wird. Demnach bestätigt sich die Hypothese einer Assoziation zwischen kardialer Vagotonie und Flow nur teilweise. Zudem verändert Flow-Erleben beim Lesen die Herzaktivität offenbar selbst nicht und kann somit nicht als objektiver Indikator hierfür gewertet werden. Vielmehr unterstützt kardiale Vagotonie als Ausgangszustand in bestimmten Lesesituationen das Auftreten von Flow (siehe Abbildung 2).

Abbildung 2. Kardiale Vagotonie und Flow-Erleben beim Lesen

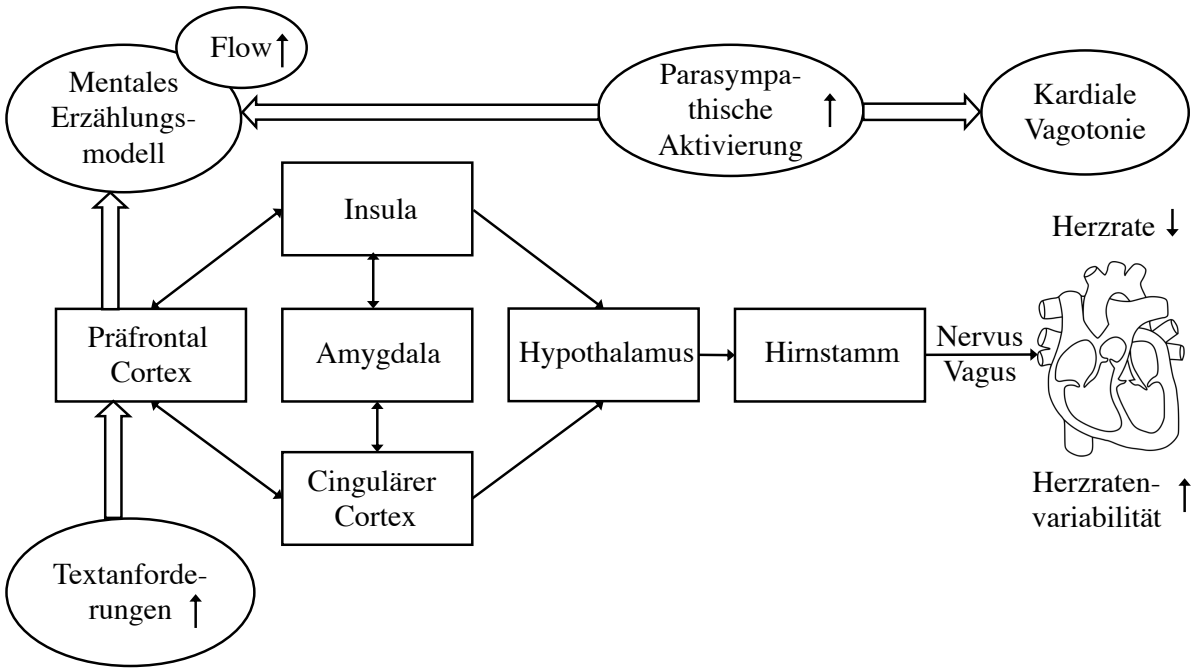

Abbildung 2. Transfer des Neuroviszeralen Integrationsmodells von Thayer & Lane (2009) auf den Lesekontext, adaptiert nach Nikolin, Boonstra, Loo und Martin (2017). Herz-Grafik heruntergeladen von https://pixabay.com/de/images/search/menschliches%20herz/

Diskussion

In dem hier vorgestellten Forschungsprojekt sollten Flow-Zustände bei Lesern empirisch nachgewiesen, Zusammenhänge zwischen Flow und anderen Konzepten zum Leseerleben modelliert und das Potenzial der Flow-Theorie für die experimentelle und psychophysiologische Leseforschung aufgezeigt werden. Anhand einer speziell an den Lesekontext adaptierten Flow-Kurzskala und eines neuentwickelten, alle Flow-Komponenten umfassenden lesespezifischen Fragebogens konnte stichhaltige Evidenz für Flow-Zustände beim Lesen erbracht werden. Es zeigte sich zudem, dass Flow als zentraler Prädiktor für Lesefreude, Textverständnis und vielschichtige Leseerlebnisse eine Schlüsselrolle im Leseprozess einnehmen kann, nicht zuletzt durch die Vermittlung anderer Erlebnisformen wie Presence. Auch unter kontrollierten Laborbedingungen war es möglich, Flow bei Lesern zu beobachten. Das Zusammenspiel von Faktoren auf Seiten von Text und Leser konnte hierbei insofern demonstriert werden, als kardiale Vagotonie, ein psychophysiologischer Indikator für innere Entspannung beim Leser, und der stilistische Anspruchsgrad des Textes in Interaktion miteinander Flow vorhersagten. Jedoch fanden sich keine Hinweise auf eine Veränderung der Herzaktivität durch Flow-Erleben beim Lesen oder auf ein über Lesesituationen hinweg mit Flow assoziiertes kardiovaskuläres Muster, das als objektiver Flow-Indikator dienen könnte.

Psychometrische Erfassung von Flow beim Lesen

Über alle drei Studien hinweg wurden mithilfe von speziell an den Lesekontext angepassten Skalen Selbstauskünfte über Flow-Erleben bei Lesern gesammelt. Anhand der im Mittel durchgängig relativ hohen Flow-Scores in der insgesamt circa 600 Leser umfassenden Stichprobe konnte gezeigt werden, dass das Lesen fiktiver Texte mit Flow-Zuständen einhergehen kann. Grundlage für diese Beobachtung war der Nachweis, dass eine psychometrischen Gütekriterien genügende Messung von Flow beim Lesen über Selbstauskunfts-Skalen möglich ist. Sowohl für die in Studie 1 von einer allgemeinen Flow-Skala adaptierte RFSS als auch für

die in Studie 2 entwickelte FRFS liegen Hinweise vor, die auf eine reliable und valide psychometrische Erfassung des Flow-Erlebens beim Lesen hindeuten. Während die RFSS eine direkte Anbindung an die allgemeine Flow-Forschung ermöglicht, ist die FRFS insofern als geeigneter für eine genaue und umfassende Flow-Messung im Lesekontext zu bewerten, als sie alle Flow-Komponenten lesespezifisch erfasst. Gleichzeitig legitimiert die Faktorenstruktur der FRFS die Berechnung eines übergeordneten Flow-Scores, wohingegen dessen Berechnung bei der RFSS lediglich auf die hohe interne Konsistenz und Korrelation ihrer beiden Faktoren gestützt werden kann. Dieses Ergebnis verweist auf die Vorteile aktivitätsspezifischer Flow-Skalen und zeigt die Notwendigkeit auf, Flow in mentalen und nicht-mentalen Aktivitäten mit entsprechend unterschiedlich konstruierten Fragebögen zu messen.

Konzeptionelle Besonderheiten von Flow beim Lesen

Gewichtung der Flow-Dimensionen. Bei der Entwicklung und Testung beider Skalen bestätigten sich auch die bereits in der theoretischen Betrachtung der Flow-Komponenten im Lesekontext offenkundig gewordenen Besonderheiten im Hinblick auf Verarbeitungsflüssigkeit beim Flow-Erleben von Lesern. So wies die in Studie 1 entwickelte RFSS im Gegensatz zur in der allgemeinen Flow-Forschung gebräuchlichen Original-Skala eine Faktorenstruktur auf, bei der die Mehrzahl der Items – darunter auch einige ursprünglich in Hinblick auf Verarbeitungsflüssigkeit formulierte – auf Absorption als latentem Faktor luden. Allerdings belegte Studie 2, dass sich auch Verarbeitungsflüssigkeit in diesem Kontext reliabel und valide erfassen lässt, wenn wie bei der FRFS spezielle Items hierfür entwickelt werden. Dennoch legen die Schwierigkeiten, die teilweise bei der Formulierung und Validierung der Verarbeitungsflüssigkeits-Items aufgetreten sind, nahe, dass Flow-Forschung bei mentalen Aktivitäten wie dem Lesen besonderes Augenmerk auf eine angemessene Konzeptualisierung dieser Flow-Dimension legen sollte. Vor dem Hintergrund, dass die verschiedenen Dimensionen von Flow über Aktivitätskontexte hinweg möglicherweise unterschiedlich zu gewichten

sind (Rheinberg & Vollmeyer, 2001), mag hierin auch ein Hinweis dafür liegen, dass Absorption im Lesekontext das prominentere Merkmal des Flow-Erlebens darstellt. Die Abgrenzung von reiner Absorption zu Flow stellt eine wichtige Aufgabe für die zukünftige Forschung dar, zumal primär über Absorption konzeptualisierte Flow-Zustände generell ein interessantes Konzept für die Medienpsychologie sein könnten, auch in Bezug auf die Rezeption von Filmen oder Social-Media-Inhalten.

Optimale Stimulierung beim Lesen. Neben dem möglichen Fokus auf Absorption könnte ein geringerer Einfluss des Herausforderungsgrads auf die Entwicklung von Flow eine weitere konzeptuelle Besonderheit im Lesekontext darstellen. Sowohl in Studie 1 als auch in Studie 2 ließ sich zwar der zu erwartende Zusammenhang zwischen subjektiv optimaler Herausforderung und Flow beobachten, jedoch ebenso die Tendenz, dass auch als leicht unterfordernd eingeschätzte Lesetexte teilweise mit hohen Flow-Scores einhergingen. In Studie 3 erzeugten die stilistisch besonders einfach oder schwierig geschriebenen Textversionen vergleichbares Flow-Erleben bei Lesern wie die mittelgradig anspruchsvoll geschriebene und somit theoretisch eher Flow-induzierende Version. Auch wenn methodische Limitationen beim Erfragen subjektiver Herausforderung (Landhäußer & Keller, 2012) und über den Schreibstil hinausgehende Anforderungsaspekte im Lesetext (Sherry, 2004) bei der Interpretation dieser Ergebnisse zu beachten sind, könnten aufgrund des fehlenden Leistungsbezugs beim Lesen tatsächlich weniger die Herausforderungen und Fähigkeiten entscheidend für Flow sein, sondern vielmehr, inwiefern der Text die Motive des Lesers implizit oder explizit bedient. So postulieren Schiepe–Tiska und Engeser (2012) in Anlehnung an Csikszentmihalyis (1975) ursprüngliche Konzeptualisierung von Herausforderungen als Handlungsmöglichkeiten, dass das Herausforderungsempfinden bei Aktivitäten ohne direkten Leistungsbezug stark von persönlichen Motiven und den Möglichkeiten, diese im Rahmen einer Handlung befriedigen zu können, abhängt.

Implikationen für die experimentelle Flow-Forschung im Lesekontext

Vor diesem Hintergrund würde sich bei experimentellen Studien zu Flow-Aktivitäten ohne konkreten Leistungsbezug der Fokus von Manipulationen auf Ebene der Aktivität und ihrer Anforderungen auf Manipulationen auf Ebene der Person und ihrer Motive verschieben. Shahian et al. (2017) konnten im Rahmen eines quasi-experimentellen Studiendesigns, in dem das Thema des Texts mit dem Vorwissensgrad der Leser abgestimmt wurde, bereits nachweisen, dass Faktoren auf der Seite der Leser für die Implementierung von Flow-Studien genutzt werden können. Möglicherweise lassen sich über eine Manipulation der Passung von Text und Lesermotiven auch validere Kontrollbedingungen erstellen, da so anstatt Über- oder Unterforderung gezielt Langeweile induziert werden könnte. Zukünftige Leseexperimente zu Flow sollten daher auf Lesermotive und -interessen fokussierte Paradigmen erproben und Flow-Zustände beim Lesen primär mit Langeweile kontrastieren, wodurch auch das Portfolio experimenteller Paradigmen in der Flow-Forschung erweitert würde.

Hierbei gilt es, auch die Zusammensetzung der Leser-Stichprobe genau zu beachten, zumal die fehlenden Gruppenunterschiede in Studie 3 angesichts des Expertisegrads der Teilnehmer auch auf Deckeneffekte zurückzuführen sein könnten. Analog zur von Csikszentmihalyi (1975, 1990) eingeführten *autotelischen Persönlichkeit*, die sich dadurch auszeichnet, über viele Tätigkeitskontexte hinweg zu Flow-Erleben zu neigen, gibt es eventuell eine Art autotelische Leserpersönlichkeit, die durch unterschiedlichste Lesetexte stimuliert und in den Flow versetzt wird. Handelt es sich, wie in den drei soeben beschriebenen Studien, um Samples aus Personen, die dem Lesen generell viel abgewinnen können, lässt sich Flow vermutlich eher auch in augenscheinlich suboptimalen Lesesituationen beobachten.

Potenzial des Lesekontexts für die psychophysiologische Flow-Forschung

Das Auftreten von Flow-Erleben beim Lesen selbst unter kontrollierten Laborbedingungen in Studie 3 ist insofern als Erfolg zu werten, als es die Bearbeitung kausaler Frage-

stellungen und psychophysiologischer Hypothesen ermöglicht. In Bezug auf letzteres bietet sich Lesen als Forschungskontext in besonderem Maße an, da es sich um eine mit geringer Bewegung und körperlicher Anstrengung verbundene Aktivität handelt, die auch angeschlossen an psychophysiologische Messgeräte relativ problemlos ausgeführt werden kann. Bislang liegt der Fokus psychophysiologischer Flow-Studien häufig auf Aktivitäten, die mit körperlicher Erregung einhergehen (Knierim et al., 2018). Die teilweise gegenläufigen Ergebnisse psychophysiologischer Forschung, beispielsweise zur Höhe des typischerweise mit Flow verbundenen Erregungsgrads (Keller et al., 2011; Peifer, Schulz, Schächinger, Baumann, & Antoni, 2014), legen nahe, dass der Aktivitätskontext bei der Ergebnisinterpretation beachtet werden sollte (Tozman et al., 2017). Daher erscheint es ratsam, Flow sowohl bei nicht-mentalen als auch bei mentalen Aktivitäten zu untersuchen, um mit Flow assoziierte psychophysiologischen Muster von aktivitätsabhängigen Beobachtungen unterscheiden zu können.

Ein besonderer Anreiz psychophysiologischer Flow-Forschung liegt in der Verbesserung von Vorhersagemodellen für Flow durch psychophysiologische Indikatoren (Bastarache–Roberge, Léger, Courtemanche, Sénécal, & Fredette, 2015; Bian et al., 2016; Harmat el al., 2015; Léger et al., 2014) und in der Überlegenheit multimethodaler Messansätze gegenüber reiner Selbstauskünfte (Peifer, 2012). Jedoch erscheint es angesichts der Ergebnisse von Studie 3 fraglich, inwieweit psychophysiologische Maße tatsächlich als Indikatoren für Flow dienen können, da zwar kardiovaskuläre Korrelate von Flow beim Lesen gefunden wurden, diese aber nicht über Lesesituationen hinweg stabil blieben. Zudem zeigte sich durch das Verschwinden der Effekte bei Berücksichtigung der individuellen kardiovaskulären Baseline, dass nicht das Flow-Erleben die Herzaktivität der Leser veränderte, sondern deren kardiovaskulärer Ausgangszustand die Auftretenswahrscheinlichkeit von Flow. Demnach wären psychophysiologische Korrelate von Flow weniger als objektive Indikatoren für dessen Auftreten zu betrachten, sondern vielmehr als Faktoren auf Seiten der Person, die in Interaktion mit

Faktoren auf Seite der Aktivität das Flow-Erleben beeinflussen. Die psychophysiologische Flow-Forschung sollte sich daher verstärkt mit individuellen Unterschieden und unter bestimmten Anforderungsbedingungen vorteilhaften inneren Zuständen befassen.

Flow und parasympathische Aktivierung beim Lesen. Kardiale Vagotonie scheint bei mentalen Aktivitäten wie dem Lesen insofern ein besonders interessantes psychophysiologisches Konzept zu sein, als sie parasympathische Dominanz indiziert, die wiederum in Interaktion mit dem Anforderungsgrad der Aktivität Flow begünstigt. Handelt es sich wie beim Lesen um eine mentale Aktivität ohne konkreten Leistungsbezug, bei der, wie oben ausgeführt, Anforderungen vermutlich eine untergeordnete Rolle spielen, so ist Anforderungsbewältigung eher als notwendige Grundvoraussetzung für Flow zu sehen, ohne die es nicht zu optimaler Stimulierung kommen kann. Beim Lesen stellt die Bewältigung stilistischer Textanforderungen offenbar die Grundlage für Flow-Erleben dar, während die Stimulierung von Lesermotiven durch den Inhalt der Geschichte entscheidend für das tatsächliche Auftreten von Flow sein dürfte. In diesem Sinne muss bei der theoretischen Anbindung von Flow beim Lesen an das Neuroviszerale Integrationsmodell zwischen dem Einfluss kardialer Vagotonie auf die kognitive Verarbeitung stilistischer Textaspekte einerseits und inhaltlicher Textaspekte andererseits differenziert werden. Während kardiale Vagotonie kognitive Prozesse bei der stilistischen Verarbeitung des Texts und somit Flow-Erleben beim Lesen stilistisch anspruchsvoller Texte zu erleichtern scheint, findet sich kein solcher Effekt bei einfach geschriebenen Texten, also offenbar nicht in Bezug auf die inhaltliche Verarbeitung des Texts. Dementsprechend sollten unterschiedliche kognitive Prozesse bei der Konstruktion mentaler Erzählungsmodelle (Kintsch & Van Dijk, 1978) womöglich auch unter verschiedenen psychophysiologischen Gesichtspunkten betrachtet werden.

Kardiale Vagotonie und parasympathische Aktivierung haben sich in Bezug auf die Erforschung grundlegender stilistischer Verarbeitungsprozesse beim Lesen als potenzielle

Flow-Korrelate bewährt, es obliegt jedoch zukünftigen Studien, psychophysiologische Korrelate für eine optimale inhaltliche Stimulierung zu finden. Somit würde sich auch bei der Suche nach psychophysiologischen Flow-Indikatoren der Fokus von einzelnen Maßen auf die Kombination mehrerer Maße verschieben. Vor diesem Hintergrund erscheint besonders die bisweilen als Flow-typisch diskutierte Co-Aktivierung von Sympathikus und Parasympathikus interessant (De Manzano et al., 2010), anhand derer sich Flow effektiv von Normalzuständen unterscheiden ließe (Knierim et al., 2018). Ähnlich wie Flow in anderen Aktivitätskontexten offenbar durch körperliche Erregungszustände und sympathische Aktivierung geprägt ist, die durch parasympathische, entspannende Einflüsse moduliert werden (Ullén et al., 2010), könnte die im Flow beim Lesen gefundene Entspannung und parasympathische Dominanz zeitweise sympathischen, anregenden Einflüssen unterliegen. So erscheint es denkbar, dass emotionale Leserreaktionen bei optimaler inhaltlicher Stimulierung punktuell zur Aktivierung des mit Erregung assoziierten Sympathischen Nervensystems führen (Wallentin et al., 2011). Da Studie 3 aufgrund der fehlenden Maße für sympathische Aktivierung und wegen des Aggregierens von kardiovaskulären Daten über längere Zeiträume keine Aussagen hierzu erlaubt, sollten zukünftige Studien unterschiedliche psychophysiologische Maße kombinieren und psychophysiologische Dynamiken im Leseverlauf erfassen.

Flow als Katalysator für multidimensionales positives Leseerleben

Ein Nachweis von Sympathikus-Reaktionen auf inhaltliche Textaspekte bei Lesern im Flow würde auch die theoretische Annahme stützen, dass diese besonders elaborierte mentale Erzählungsmodelle konstruieren, die wiederum ein intensiveres Leseerleben erlauben. Hierzu passen auch die in Studie 1 und 2 gefundenen hohen Korrelationen von Flow mit anderen Erlebnisformen beim Lesen und der zentrale Stellenwert von Flow für multidimensionales Leseerleben in Studie 2. So geht Flow beim Lesen offenbar häufig mit Presence, Identifikation und Spannung einher, ist jedoch nur auf indirekte Weise mit kognitiver Involvierung ver-

bunden. Letzteres ist vermutlich auf den hohen Absorptionsgrad im Flow zurückzuführen, dem über den Text hinausgehende Gedanken teils entgegenwirken dürften (Knobloch-Westerwick & Keplinger, 2008). Angesichts der dennoch positiven Korrelation und des indirekten Effekts von Flow auf kognitive Involvierung erscheint es jedoch denkbar, dass bestimmte Lesertypen durch Flow zur kognitiven Involvierung animiert werden oder dass Flow kognitive Involvierung zu einem späteren Zeitpunkt im Leseprozess begünstigt.

Obwohl Flow somit direkt oder indirekt eng mit anderen Erlebnisformen beim Lesen verbunden ist, deutet faktoranalytische Evidenz aus Studie 1 und 2 darauf hin, dass Flow durchaus einen eigenständigen Zustand im Erleben von Lesern darstellt. Wie das in Studie 2 vorgestellte Modell zu multidimensionalem Leseerleben veranschaulicht, scheint der Flow-Zustand dabei als eine Art Katalysator zu wirken, der nicht nur selbst, sondern auch durch andere Erlebnisformen einen positiven Effekt auf das Leseerleben hat. Besonders interessant hierbei ist, dass einige der anderen Erlebnisformen beim Lesen in Studie 2 negative Effekte auf Lesefreude oder Textverständnis hatten. Demnach können Konzepte wie Presence, Identifikation und kognitive Involvierung je nach Lesetext offenbar eine ambivalente Wirkung auf das Leseerleben haben, im Gegensatz zu Flow und Spannung. Für Spannung konnte bereits nachgewiesen werden, dass diese im Stande ist, negative Aspekte eines Leseerlebnisses in positive umzuwandeln (Hoffner & Levine, 2005). Angesichts der in Studie 2 gefundenen Hinweise darauf, dass sowohl Flow als auch Spannung als negative Suppressoren fungierten, also positiv mit dem Leseerleben assoziierte Varianz in ansonsten ambivalenteren Erlebnisformen aufklärten, sollte in Zukunft geprüft werden, inwieweit Flow ebenfalls zu einer positiven Wahrnehmung ansonsten negativer Erlebnisformen beim Lesen führt.

Da die bisherigen Ergebnisse die Relevanz des Flow-Konzepts für die Leseforschung bestätigen, erscheint es sinnvoll, Flow auch bei anderen mit Lesen assoziierten Forschungsthemen zu berücksichtigen. Beispielsweise verweist der in Studie 2 gefundene positive Effekt

von Flow auf tiefergehendes Textverständnis bei fiktiven Erzählungen auf das Potenzial der Flow-Theorie für die anwendungsorientierte, pädagogische Leseforschung und für Lesestudien zu Sach- und Lerntexten. Auch legt die starke Assoziation von Flow und Lesefreude nahe, weitere positive Aspekte des Leseerlebens im Hinblick auf Flow zu untersuchen, wie etwa ästhetisches Gefallen. Dies ist insofern besonders interessant, als die Flow-Theorie und ihr Grundgedanke der optimalen Stimulierung der *Processing Fluency Theory of Aesthetic Pleasure* (Reber, Schwarz, & Winkielman, 2004) verwandt sind, die besagt, dass Verarbeitungsflüssigkeit bei der Rezeption von Kunst eine inhärent affektive Komponente aufweist (Winkielman & Cacioppo, 2001; Winkielman, Schwarz, Fazendeiro, & Reber, 2003).

Sollte sich Flow im Rahmen der Leseforschung weiterhin bewähren, würde dies auch eine stärkere Ausweitung der Flow-Forschung auf mentale Aktivitätskontexte bestärken. So könnte Flow zu einem Schlüsselkonzept an der Schnittstelle von positiver Psychologie und Medienpsychologie avancieren, da Lesefreude als Beispiel für die positive mentale Rezeption von medialen Inhalten angesehen werden kann. Legt man den im Rahmen dieses Forschungsprojekts gewonnenen Erkenntnissen das Verständnis von Lesen als multidimensionalem Erlebnis zugrunde, bei dem der Leser aktiv ein mentales Erzählungsmodell konstruiert, so ergibt sich das Bild einer mentalen Flow-Aktivität, bei der Flow aufgrund des speziellen Aktivitätskontexts mit einer Reihe anderer Erlebnisformen und Outcomes einhergeht. In Anbetracht der eingangs beschriebenen positiven Effekte, die Leseerlebnisse vermutlich vor allem dann haben können, wenn sie mit Lesefreude einhergehen, erscheint die Erforschung von Flow als zentralem Element des positiven Leseerlebens maßgebend (siehe Abbildung 3).

Abbildung 3. Multidimensionales positives Leseerleben basierend auf Flow

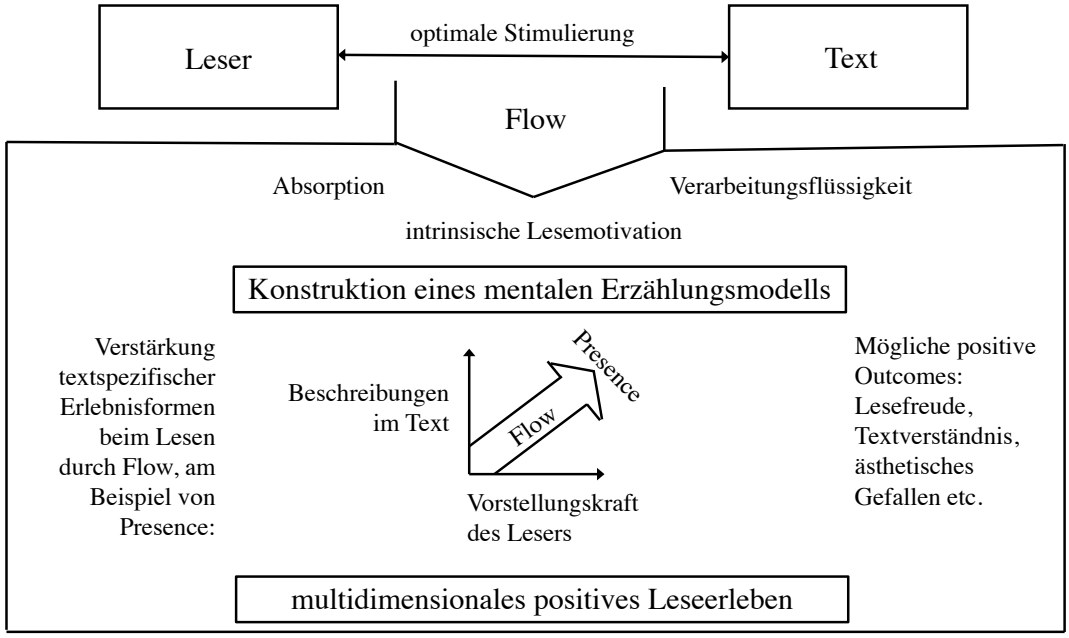

Abbildung 3. Integration des ursprünglichen Flow-Modells nach Csikszentmihalyi (1975) in ein umfassendes Modell des Leseerlebens beim Lesen fiktiver Texte.

Limitationen

Um die Erforschung von Flow beim Lesen auf sinnvolle Weise voranzutreiben, ist es unabdingbar, sich mit den Limitationen der bisher durchgeführten Studien auseinanderzusetzen. Zum einen sind hierbei Einschränkungen in der Generalisierbarkeit der Ergebnisse zu nennen, da bislang ausschließlich leseaffine Personen untersucht wurden, die im Durchschnitt über einen hohen Bildungsgrad verfügten und in der Mehrzahl weiblich waren. Zum anderen können in den Online-Studien Einschränkungen der Datenqualität – einerseits durch nachlässige Bearbeitung der Umfragen angesichts der Studiendauer und andererseits durch extrinsische Teilnahmemotive angesichts der monetären Vergütung – nicht vollständig ausgeschlossen werden, obwohl Kontrollfragen (Meade & Craig, 2012) eingebettet und Teilnehmer aufgrund unrealistischer Lesezeiten aus der Datenanalyse entfernt wurden. In der Laborstudie dagegen bleibt fraglich, inwieweit sich die Lesesituation trotz der speziellen Gestaltung des Laborraumes und der Verwendung mobiler Messgeräte vom normalen Leseerleben unterschied. Zu diesen im Studiendesign begriffenen Limitationen kommt hinzu, dass die bisher

durchgeführten Studien keine abschließenden Ergebnisse zu Flow beim Lesen liefern können: So stehen weitere Validierungsbemühungen hinsichtlich der zur lesespezifischen Flow-Messung entwickelten Instrumente anhand unterschiedlicher Leser- und Text-Samples und Replikationsstudien in Bezug auf das dem Flow-Erleben zugrundeliegende kardiovaskuläre Aktivierungsmuster noch aus.

Fazit und Forschungsausblick

Trotz der dargelegten Einschränkungen konnten die durchgeführten Studien erste Einblicke in Flow beim Lesen liefern, die die Relevanz dieses Konzepts in Bezug auf Leseerleben bestätigen. Demnach steht Flow in Zusammenhang mit textspezifischen Erlebnisformen, wie etwa Spannung, und mit genereller Lesefreude, Textverständnis und Entspannung. Auch liegt mit den durchgängig hohen mittleren Flow-Scores empirische Evidenz dafür vor, dass es sich bei Flow um einen bei Lesern verbreiteten Zustand handelt. Da Flow theoretisch und faktoranalytisch über die bisher in der Leseforschung diskutierten Konzepte hinausgeht, bietet sich hierin ein neuer Ansatz zum Verständnis von Leseerleben. So scheint Flow ein wichtiges Bindeglied und ein Katalysator für unterschiedliche positive Aspekte des Leseerlebens zu sein und könnte mittels des Flow-Modells wesentlich zu deren Vorhersage beitragen. Durch die Erkenntnis, dass Flow beim Lesen mit kardiovaskulären Aktivierungsmustern in Verbindung gebracht und in experimentellen Settings gezielt hervorgerufen werden kann, eröffnet sich eine Bandbreite neuer Möglichkeiten für die Leseforschung. Forschungsschwerpunkte könnten in Zukunft etwa in der Auswirkung von Flow beim Lesen auf Lernleistung, Meinungsbildung, Wohlbefinden oder Stressabbau liegen, Anwendungskontexte hingegen in der Gestaltung von Texten und Curricula. Zudem sind mentale Aktivitäten wie Lesen ein wichtiges, noch kaum erforschtes Gebiet für die Flow-Forschung. Flow-Zustände im Lesekontext stellen somit zwar ein sehr spezifisches, jedoch ein in vielerlei Hinsicht interessantes Thema für die psychologische Forschung dar.

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Measuring Optimal Reading Experiences: The Reading Flow Short Scale

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In transferring the concept of flow to the context of fiction reading a new approach to understanding the evolvement of reading pleasure is provided. This study presents the Reading Flow Short Scale (RFSS), the first reading-specific flow measurement tool. The RFSS was applied to 229 readers via online survey after 20 min of reading in self-selected novels. In a systematic analysis of psychometric properties, the RFSS' factorial structure, reliability, and associations with theoretically related constructs were examined. As expected, the RFSS showed a two-factor structure, positive correlations with variables related to reading pleasure and flow, and an inverted U-shaped association with perceived fit between reader skills and text challenge. Comparisons of confirmatory factor analysis model confirmed that RFSS items loaded on different latent variables than items assessing other narrative engagement concepts, namely presence, identification, suspense, and cognitive mastery, and hence distinctly capture flow states in fiction reading. In sum, our findings indicate that the RFSS is a useful instrument for assessing flow states in fiction reading, thereby enriching the portfolio of measurement instruments in reading research.

Keywords: flow, fiction reading, Reading Flow Short Scale, validity, reading pleasure

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INTRODUCTION

Considering the growing body of empirical evidence on positive effects of fiction reading (Mar et al., 2011; Kidd and Castano, 2013; Vezzali et al., 2015), there is still relatively little consensus regarding the mental mechanisms involved in making reading itself an inherently rewarding experience. Reading pleasure has been discussed to be mediated by the reader's change of consciousness (Nell, 1988), which can occur both in response to text-inherent incitements and the activity of reading itself. Thus, on the one hand, reading fictional texts can elicit specific pleasure-related states in the reader as a direct reaction to engagement with certain story elements. Amongst the most prominent concepts of pleasure-related narrative engagement are *presence* (Lee, 2004), *suspense* (Zillmann, 1996), *identification* (Cohen, 2001), and *cognitive mastery* (Oliver and Raney, 2011). While presence states are defined as the sensation of being in the story world, states of heightened reader suspense pertain to the anticipation of emotionally charged story events. A state of identification is characterized by the internalization of story-characters' feelings and thoughts, and cognitive mastery states arise from the sense of retrieving meaning, truth and purpose from the story. Depending on the narrative the reader engages with, varying degrees and combinations

of presence, suspense, identification, and cognitive mastery might occur and contribute to making the reading experience pleasurable.

On the other hand, the activity of reading itself can cause the reader to enter a pleasurable state of heightened absorption or even *flow* (Csikszentmihalyi, 1975). Flow states are defined as the optimal experience of being fully engaged in an activity and have been used throughout the field of positive psychology as a theoretical framework for intrinsic enjoyment. Whenever the degree of challenge in a given activity perfectly matches a person's individual skill level, the person will experience flow (Csikszentmihalyi, 1975). Optimally balanced skills and challenges and flow experiences have been shown to increase subjective involvement and enjoyment of activities (i.e., Keller and Bless, 2008; Keller and Blomann, 2008), supporting the conceptualization of flow as a motivator for repeated activity engagement (Csikszentmihalyi, 1975). Furthermore, flow has been positively associated with personal preferences and self-efficacy in regard to a certain activity (Rheinberg et al., 2003).

Several authors have offered theoretical considerations on flow and enjoyment of narratives (i.e., Muth, 1996; Busselle and Bilandzic, 2008; Weber et al., 2009), discussing flow during reading as a key element of reading pleasure. While engagement with a specific narrative can lead to different pleasure-related states, such as presence, identification, suspense, and cognitive mastery, engagement with the activity of reading itself, or more precisely with the activity of constructing a mental model of the story (Busselle and Bilandzic, 2008), can lead to a flow state. Reading pleasure should therefore be considered a multi-dimensional experience, with flow as one of its components and a potential mediator for others. In contrast to other concepts discussed as being part of a pleasurable reading experience, including the formerly mentioned ones, the flow concept comes with the advantage of an underlying comprehensive theoretical model from which precise predictions can be derived. Thus, predicting flow experiences in readers based on their perceived balance of text challenge and reader skills can ultimately help to make individual reading pleasure more predictable.

In order to empirically research the role of flow states in fiction reading, a psychometrically tested measurement device is needed, which assesses flow states in this specific context. To the best of our knowledge, only two studies have investigated flow experiences in fiction reading empirically so far. Massimini et al. (1988) conducted a meta-analysis of five studies surveying flow experiences in everyday life by means of a general flow measure, finding that reading ranked as the most frequently self-reported flow activity. Applying the same general flow measure to a sample of regular fiction readers instructed to fill it out with the activity of reading in mind, McQuillan and Conde (1996) reported flow to be most likely for reading fictional texts, texts related to personal interests, and for reading during leisure time. However, the flow measure employed in both studies, the Flow Questionnaire (FQ; Csikszentmihalyi and Csikszentmihalyi, 1988), has been criticized in recent flow research in terms of its conceptual and psychometric properties, with major points of critique being its lacking differentiation between high or low levels of flow, its systematic underestimation of flow prevalence in specific contexts, and its proneness to distortion through memory effects (Moneta, 2012). To overcome such limitations, flow research has widely adopted the so called componential measurement approach (Moneta, 2012), which is based on Csikszentmihalyi's (1975) conceptualization of flow as a multi-componential state of mind. Thus, flow states are characterized by nine components (Csikszentmihalyi, 1975; Jackson and Marsh, 1996): (1) *merging of action and awareness*, (2) *attentional focus*, (3) *loss of self-awareness*, (4) *sense of control or competence*, (5) *perception of coherent, non-contradictory demands*, (6) *intrinsic enjoyment*, (7) *distorted sense of time*, (8) *perception of clear goals*, and (9) *perception of unambiguous feedback*. Componential flow measures collect self-report ratings on how far individuals experience each of these flow components directly after engagement in an activity, from which subsequently a joint flow score is calculated (Jackson and Eklund, 2002; Rheinberg et al., 2003). Flow scales of this type have been shown to significantly outperform other measurement approaches, including the FQ, in terms of psychometric properties (Moneta, 2012).

In the last decades, several componential flow scales have been developed, both for flow measurement in specific contexts, such as work (Bakker, 2008) or internet surfing (Novak and Hoffman, 1997), and for flow measurement across activities (Jackson and Marsh, 1996; Rheinberg et al., 2003; Jackson et al., 2008). One particularly prominent general flow scale in European flow research is the Flow Short Scale (FSS; Rheinberg et al., 2003), a brief 13-item measure, with three supplemental items assessing perceived balance of skills and challenges. The FSS has been shown to have good psychometric properties ($\alpha = 0.90$), a stable 3-factor structure comprising Absorption, Smooth Processing, and Concern, and the expected associations with theoretically related constructs such as skills-challenge balance, performance, and self-efficacy, supporting the scale's validity (Rheinberg et al., 2003). The original German-language scale has been translated to different languages (for an overview see Rheinberg, 2015), including English (Engeser and Rheinberg, 2008), and applied across a wide range of flow activities, such as marathon running (Schüler and Brunner, 2009), computer gaming (Weibel and Wissmath, 2011), and learning (Vollmeyer and Rheinberg, 2006).

Even though the FSS has been designed as a general flow scale, its applicability to fiction reading is limited as the wording of certain items implies engagement in a motoric, performance-related, and competitive activity, which makes sense for most typically studied flow contexts, but not for this one. Particularly, the subdimension of Concern, which measures an absence of fear of failure, does not match the non-performance-related context of fiction reading. Thus, fiction reading can to some degree be seen as a specific flow context, in which optimal challenge levels primarily refer to stimulation instead of achievement and in which the activity itself is primarily mental instead of motoric. While these characteristics do not directly interfere with the applicability of the various flow components themselves to the context of fiction reading, they do interfere with certain items intended to measure them on general scales such as the FSS. Therefore, any valid measure of flow in fiction reading has to

be specific in the sense that it needs to be adapted to the special characteristics of this activity.

We know of only one scientific endeavor to formulate reading-specific flow items, which were constructed as part of a bigger reading-experience measure (Appel et al., 2002). However, these items substantially deviate from the componential measurement approach as they only measure intrinsic enjoyment and perception of coherent demands, neglecting other flow components. Moreover, since flow was not a focus of the corresponding study, the items were not systematically tested for validity. Given the lack of conceptually and psychometrically sound reading-specific flow measures, we developed a new instrument, the Reading Flow Short Scale (RFSS), by adapting the FSS to fiction reading. In the current study, (1) we investigated the RFSS' factorial structure and reliability, and (2) further explored its construct validity in terms of associations with theoretically flow-related constructs and its differentiability from other pleasure-related concepts of narrative engagement.

MATERIALS AND METHODS

Scale Development

We derived the RFSS from the FSS by dropping its 3-item subdimension Concern, which applies to competitive flow activities only, and by rephrasing the 10 remaining items on the subscales Absorption and Smooth Processing to ensure good fit to the context of fiction reading. For items on the Absorption subdimension this was sufficiently achieved by integrating specific references to reading into the item wording (i.e., "I did not notice time passing."/"I did not notice time passing during reading."). The items on the Smooth Processing subdimension partly required more throughout rewording (i.e., "The right thoughts and movements occured on their own account."/"Thoughts, emotions, and images emerged automatically and spontaneously, inspired by what I was reading."). All rephrased items were submitted to flow experts for approval. **Table 1** shows the final 10 RFSS items, to be answered on a seven-point Likert-type scale ranging from *strongly disagree* to *strongly agree*.

Design and Procedure

An online survey was set up using Unipark/EFS Survey and made accessible from April to July, 2016. In the survey, participants were instructed to read on in a self-selected novel for 20 min. When reading time was over, a timer embedded in the online survey rang a signal. Participants then completed the RFSS, items assessing perceived skills-challenge balance, convergent measures assessing reading and reader variables and previous reading-related flow experiences, as well as discriminant measures assessing presence, identification, suspense, and cognitive mastery.

After survey completion, respondents could enter a lottery to win one of 70 online book vouchers worth 20€ each. The survey itself was anonymous; participation was voluntary and could be withdrawn at any time. All procedures were ethically approved by the Ethics Council of the Max Planck Society and were undertaken with informed consent of each participant.

Participants

Participants were recruited by disseminating flyers in local bookstores, during public readings, and in undergraduate literature courses at the local Goethe University, as well as by sharing the survey link on Facebook and in reading forums. Mean duration for survey completion was 45.3 min, including 20 min during which participants read on in a novel they were currently reading. The most frequent novel genres read in the sample were *Fantasy* (14%), *Crime/Thriller* (14%), *Social Novel* (13%), *Psychological Novel* (12%), and *(Melo-)Drama* (8%). To ensure its potential for reader engagement, the novel read in the study had to meet the criteria of being self-selected, already finished halfway, written in a language the participant is fluent in,

TABLE 1 | RFSS items with mean scores, factor loadings and communalities for exploratory factor analysis with Geomin rotation.

	Item	*M (SD)*	Factor loadings		h^2
			Factor 1	Factor 2	
1	I felt optimally challenged during reading.	5.39 (1.46)	**0.48**	−0.01	0.23
2	I read this text smoothly and fluently.	5.76 (1.35)	0.11	**0.60**	0.45
3	I did not notice time passing during reading.	5.34 (1.58)	**0.59**	0.12	0.43
4	I had no problem to concentrate during reading.	5.50 (1.50)	0.35	0.34	0.35
5	My mind was totally clear during reading.	5.43 (1.47)	0.33	0.34	0.35
6	I was completely immersed in what I was reading.	5.36 (1.36)	**0.82**	0.03	0.71
7	Thoughts, emotions, and images emerged automatically and spontaneously, inspired by what I was reading.	5.50 (1.39)	**0.46**	0.07	0.25
8	I knew on every page that I was able to grasp the story.	6.16 (1.22)	−0.04	**0.82**	0.64
9	I had the feeling that I understood everything during reading.	4.58 (1.62)	**0.79**	−0.01	0.54
10	During reading I became so oblivious that I became completely unaware of myself.	6.07 (1.19)	0.02	**0.73**	0.56
% of variance			25.00	20.00	

Factor loadings >0.40 are in boldface. Percentage variance is post-rotation. Items 4 and 5 were later removed from the RFSS due to cross-loadings. All items were adapted from the Flow Short Scale by F. Rheinberg et al. (2003).

and telling an unfamiliar story. For not meeting these criteria, 98 readers were excluded before they could start the survey. Another five participants were excluded afterward because their answers to control questions indicated non-attentive reading or careless response behavior (Meade and Craig, 2012).

The final sample comprised 229 participants, most of them being female (n = 181; 79%). The sample covered an age range between 18 and 81 years (M = 35.6, SD = 15.0) and showed a relatively high educational background: Thus, more than half of the participants (n = 122; 53%) held a graduate degree, another 5% (n = 12) a postgraduate degree, and 85 persons (37%) a general qualification for university entrance.

Measures

Convergent Measures

Reading and reader variables

Reading pleasure as well as motivation to read on and to read another similar story were assessed using single items on five-point Likert-type scales. Participants answered additional single items measuring general affinity for fiction reading and reading frequency in regard to fictional texts. Beliefs concerning one's own ability to comprehend and enjoy fictional texts were measured by means of a 4-item reading-specific self-efficacy scale (see **Table 2**; McDonald's ω = 0.62 [0.49, 0.70]), which had been developed on the basis of two general self-efficacy scales (Engeser, 2005; Beierlein et al., 2012). All ratings and rating scores were expected to be positively associated with flow and hence positively correlated with the RFSS flow score due to the close conceptual link between flow and intrinsic enjoyment, repeated activity engagement, personal preference, and self-efficacy.

Previous reading-related flow experiences

In order to identify readers generally prone to flow experiences, participants were inquired about previous reading-related flow experiences. Therefore, a flow state in fiction reading was described to them by systematically transferring flow components to this context:

There are readers, who have the feeling to fully immerse in the activity during reading. Then, they block out themselves, their everyday life, and their surroundings for a certain period of time and fully concentrate on reading. They become so focused that they lose track of time and forget everything around them. It seems like they melt with the story during reading.

The story for its part becomes accessible for them almost by itself. The readers intuitively comprehend what the story is about. Neither do they need to actively think about the text nor are they thinking about other things while they are reading. Reading and comprehending the text does not seem very exhausting to them, as if they could read on for hours without any problems. They feel

TABLE 2 | Items used for assessing presence, identification, suspense, cognitive mastery, and reading self-efficacy.

Construct	Item
Presence	When I stopped reading, I felt like I came back to the "real world" after a journey.
	During reading, my mind was in the room, not in the world created by the novel (reversed).
	During reading, my body was in the room, but my mind was inside the world created by the story.
	The story created a new world, and then that world suddenly disappeared when I stopped reading.
	At times during reading, the story world was closer to me than the real world.
Identification	I was able to understand the events in the story in a manner similar to that in which the protagonists understood them.
	I think I have a good understanding of the story's protagonists.
	I tend to understand the reasons why the protagonists do what they do.
	While reading the story, I could feel the emotions the protagonists portrayed.
	During reading, I felt I could really get inside the protagonists' heads.
	At key moments in the story, I felt I knew exactly what the protagonists were going through.
	During reading, I wanted the protagonists to succeed in achieving their goals.
	When the protagonists succeeded I felt joy, but when they failed, I was sad.
Suspense	During reading, I was really thrilled to see how the story would go on.
	I could not wait to start the next page to find out what would happen next in the story.
	I found the story so gripping, that I was hesitant to stop reading.
	It was exciting for me to imagine how the story would go on during reading.
	During reading I developed hopes and fears about how the story might end, and I was curious to find out whether they were true.
Cognitive mastery	While reading this story, I sensed something that I could not find a way to express.
	After reading this story, I felt that my understanding of life had been deepened.
	To me, the story seemed to have a deeper meaning, which I tried to figure out during reading.
	I found that reading the story was thought-provoking for me.
	During reading, I felt that I was learning new things that would enrich my view of the world.
Reading self-efficacy	If a book is interesting to me, I don't care how hard it is to read.
	If a book is interesting to me, I will read it even if it is long.
	If I don't immediately find an approach to a story, I can rely on my abilities to comprehend and feel stories.
	Most of the books I start reading, I finish within a rather short period of time.

that the story is clear, understandable, and entertaining for them and that reading this text runs smoothly and fluently.

All in all, these readers fell neither bored nor stressed, but rather optimally challenged. They know, that they will be able to emphasize and comprehend the story and that the book has sufficient quality to let them have a good time with it. They enjoy reading and are therefore highly motivated to read on in the book and to again and again engage in reading during their leisure time.

Based on this description, participants indicated in how far they had ever experienced such a state during fiction reading, how frequently they would normally experience it, and whether they consider this a typical reading experience on five-point Likert-type response scales. Quality and frequency of as well as proneness to past reading-related flow experiences were expected to show positive associations with flow during reading in the study as measured with the RFSS flow score.

Discriminant Measures

In order to contrast flow in fiction reading with other common pleasure-related narrative engagement concepts, presence, identification, suspense, and cognitive mastery were measured using specially developed short scales. Existing measures were not considered appropriate for the purpose of this study due to their long-scale format and multi-dimensional conceptualization, which would have led to a problematic degree of shared item content across scales. To avoid inflating correlations, each narrative engagement concepts was instead measured with items carefully chosen to represent its unique qualities only. For instance, the definition of identification as an imaginative process by which the characters' perspectives are internalized (Cohen, 2001) does not specifically entail absorption; however, readers who are absorbed in a story seem more likely to identify with its characters and readers that identify themselves with a character seem more likely to get absorbed in a story, so that both states presumably often coincide in fiction reading. In order to ensure accurate measurement and thus understanding of the interaction of different narrative engagement concepts in reading pleasure, it is nevertheless important to use scales that are highly specific to the concept in question. That is, a scale to measure identification in fiction reading should not include absorption-related items, since absorption is by definition not part of this concept, to avoid creating artificial conceptual overlap. Bearing in mind this need for highly concept-specific measurement, we opted for rationally constructed *ad hoc* measures of presence, identification, suspense, and cognitive mastery instead of using existing less-specific scales.

For assessing presence, five items ($\omega = 0.79$ [0.73, 0.83]) were adapted from the Telepresence Scale (Kim and Biocca, 1997) and the Narrative Engagement Scale (Busselle and Bilandzic, 2009). To measure identification, eight items were taken from the Identification Scale by Cohen (2001) ($\omega = 0.90$ [0.86, 0.93]). With regard to suspense, a five-item scale ($\omega = 0.84$ [0.79, 0.88]) was developed building on Knobloch et al. (2004) measurement approach. Cognitive mastery was assessed using a six-items scale ($\omega = 0.89$ [0.85, 0.91]) adapted from items developed to measure narrative comprehension (Kuijpers, 2014) and eudaimonia (Oliver and Raney, 2011). For all items, a seven-point Likert-type scale ranging from *strongly disagree* to *strongly agree* was employed. A full list of the items used can be found in **Table 2**.

Criterion

To assess perceived degrees of individual reader skills and text challenge in relation to the self-selected novel, we adapted two supplemental items from the FSS (Rheinberg et al., 2003): Item A *"I think my skills for reading and comprehending this book are... too low/just right/too high."*; item B *"For me personally, the degree of challenge that this book poses on the reader is... too low/just right/too high."* The middle category of the seven-point Likert-type response scales indicated perceived optimal balance. Since optimal balance of skills and challenges is the central pre-condition for flow, the RFSS flow score was expected to be predictable by self-report ratings on these two items.

Statistical Analysis

All analyses described in the following were performed using the statistical software program R v3.3.1 (R Core Team, 2016).

Exploratory Factor Analysis

Due to substantial item rewording and different domain of application, we did not expect the RFSS to fully replicate the original FSS's factorial structure. Therefore, we chose exploratory factor analysis (EFA) to test the dimensionality of the RFSS. Given the highly skewed distributions of responses, we conducted an EFA for ordered-categorical indicators based on a polychoric correlations coefficients matrix. For conducting the EFA, the principal axes factor analysis method and a maximum likelihood estimator were employed. In order to determine the number of factors to be extracted, we used parallel analysis, Velicer's MAP test, and a scree test. Subsequently, the indicated number of factors was extracted using an oblique Geomin-type rotation since different subdimensions of flow have been shown to intercorrelate (Rheinberg et al., 2003).

Validity Analysis

Based on the assumption derived from flow theory that RFSS flow scores should peak when participants report to perceive an optimal balance of skills and challenges, criterion validity was tested regressing RFSS flow scores on skills-challenge balance using polynomial regression models. To investigate convergent validity, Spearman and point-biseral correlations between RFSS flow scores and theoretically flow-related reading and reader variables were calculated. Discriminant validity was explored by calculating Spearman correlations between RFSS flow scores and presence, identification, suspense, and cognitive mastery scores. In order to confirm that RFSS items load on a distinct latent variable than items assessing presence, identification, suspense, or cognitive mastery, single-factor confirmatory factor analysis (CFA) models for ordered categorical indicators were contrasted with corresponding multi-factor models. For all CFAs a robust weighted mean- and variance-adjusted least squares estimator (WLSMV) was used, which outperforms other estimators in case of skewed data distributions (Flora and Curran, 2004). Model fit

was regarded as acceptable if the Tucker-Lewis index (TLI) was above 0.95, the comparative fit index (CFI) above 0.96, and the root mean square error of approximation (RMSEA) close to 0.05 (Yu, 2002).

RESULTS

Factorial Structure of the RFSS

The 10 RFSS items were subjected to an EFA using the principal axes factor analysis method and a maximum likelihood estimator based on polychoric correlations coefficients. Indicating sufficiently strong relationships among items, the Kaiser-Meyer-Olkin measure of sampling adequacy was 0.82. While the parallel analysis turned out inconclusive as a potential third factor lay within the error bar of 50 iterations, Velicer's MAP test suggested the extraction of two factors, which was further supported by employing a scree test. Solutions for both two and three factors were examined using oblique Geomin-type rotation. The two-factor solution was preferred as it is supported by flow theory as well as by the original FSS's factor structure, whereas the three-factor solution did not yield interpretable results. The Kaiser index of factorial simplicity (Kaiser, 1974) for the two-factor solution was 0.95, indicating a high tendency toward unifactoriality of loadings and thus further supporting this solution.

The two-factor solution, explaining 45% of the variance, showed a simple structure (**Table 1**) with clear loadings for eight items. Substantial cross-loadings of items 4 and 5 indicated ambiguous item-factor associations, which lead to the removal of these items, reducing the RFSS to eight items in total. The two factors, the remaining items loaded on, overall correspond with the Absorption and Smooth Processing subscales of the FSS, from which the RFSS was derived, and show an estimated correlation of $r = 0.55$, indicating closely related yet distinct facets of flow in reading.

To test whether the calculation of a global flow score across subscales, as indicated by the theoretical assumption of flow being a higher-order concept for a multi-dimensional state, is psychometrically justified, a CFA model with Flow as a higher-order factor needs to be conducted. This model, however, is not identified with two first-order factors only (Absorption and Smooth Processing), rendering it impossible to provide clear empirical evidence in favor or against the global flow score. We therefore tested a first-order CFA model in which all items load on just one factor (Flow), which is the closest possible approximation to testing the presumption of a global factor. The single-factor model did not show acceptable fit to the data (TLI = 0.817, CFI = 0.869, RMSEA = 0.212), further supporting the use of a two-factor model as indicated by the EFA. In the following, we report results for both the empirically validated subscale scores and the theoretically indicated global flow score.

Scale Scores and Reliability

Individual RFSS flow scores were calculated by averaging item scores by participants. The mean RFSS global flow and subscale scores (see **Table 3**) in the sample were all above the response scale's midpoint, indicating that, on average, participants did experience flow during 20 min of fiction reading. Kruskal-Wallis tests for each score revealed that neither sex nor educational background had a significant effect on flow experiences (for the corresponding subsample's scores, see **Table 3**).

Composite reliability was calculated for both the RFSS' subscale scores and for the global flow score, yielding reliability estimates of $\omega = 0.77$ [0.68, 0.82] for Smooth Processing, $\omega = 0.80$ [0.75, 0.85] for Absorption, and $\omega = 0.89$ [0.85, 0.95] for the RFSS flow score. Thus, the scale's reliability estimates significantly exceed the commonly reported cut-off value of 0.70 (Nunnally and Bernstein, 1994; Ponterotto and Charter, 2009), which is usually accepted as sufficient for group testing.

Validity

Construct Validity

Convergent validity

Table 4 shows Spearman correlations of the RFSS flow score and both its Absorption and Smooth Processing subscale scores with reading and reader variables as well as with variables related to

TABLE 3 | Mean scores and SD for flow, presence, identification, suspense, cognitive mastery, and reading self-efficacy.

Concept	Total sample		Females		Males		Academics		Non-academics	
	Mdn	*M (SD)*	*Mdn*	*M (SD)*	*Mdn*	*M (SD)*	*Mdn*	*M (SD)*	*Mdn*	*M (SD)*
Global flow	5.6	5.5 (0.9)	5.6	5.6 (0.9)	5.4	5.4 (0.8)	5.5	5.4 (0.09)	5.8	5.6 (0.8)
Absorption	5.2	5.2 (1.1)	5.4	5.3 (1.1)	5.2	5.1 (0.9)	5.1	5.2 (1.1)	5.6	5.4 (1.1)
Smooth Processing	6.3	6.0 (1.0)	6.3	6.1 (1.1)	6.0	5.8 (1.0)	6.3	5.9 (1.1)	6.3	6.1 (0.9)
Presence	5.3	5.2 (1.0)	5.3	5.1 (1.0)	5.2	5.0 (1.0)	5.2	5.1 (1.1)	5.3	5.3 (0.9)
Identification	5.3	5.2 (1.0)	5.4	5.3 (1.0)	4.9	4.9 (1.1)	5.1	5.1 (1.0)	5.5	5.4 (1.0)
Suspense	5.4	5.3 (1.2)	5.6	5.4 (1.2)	5.0	4.9 (1.2)	5.2	5.0 (1.2)	5.8	5.6 (1.1)
Cognitive mastery	4.5	4.4 (1.4)	4.5	4.4 (1.4)	4.5	4.3 (1.4)	4.6	4.4 (1.4)	4.3	4.4 (1.4)
Reading self-efficacy	4.3	4.2 (0.6)	4.3	4.2 (0.6)	4.3	4.1 (0.6)	4.3	4.2 (0.6)	4.3	4.2 (0.6)

N = 229; n = 181 for females and n = 45 for males (n = 3 no response); n = 134 for academics and n = 92 for non-academics (n = 3 no response); significant effect of gender [$\chi^2(2) = 6.25$, $p < 0.05$] and educational background [$H(2) = 15.74$, $p < 0.001$] only for suspense; flow, presence, identification, suspense, and cognitive mastery were measured on a 7-point, reading self-efficacy on a 5-point Likert-type scale.

TABLE 4 | Correlations of RFSS scale scores with reading and reader variables, previous reading-related flow experiences, and concepts of pleasure-related narrative engagement.

	RFSS scale score		
Measure	**Absorption**	**Smooth Processing**	**Global flow**
Reading and reader variables			
Reading pleasure	0.49	0.26	0.48
Motivation to read on in the novel	0.52	0.32	0.53
Motivation to read similar novel	0.23	0.13	0.23
Reading affinity	0.12	0.12	0.14
Frequency of reading fictional texts	0.13	0.21	0.18
Reading-related self-efficacy	0.23	0.20	0.25
Previous reading-related flow experiences			
Quality of past flow in fiction reading	0.27	0.20	0.28
Frequency of flow in fictional texts	0.27	0.15	0.33
Proneness to flow in fiction reading	0.34	0.25	0.35
Concepts of pleasure-related narrative engagement			
Presence	0.74	0.30	0.69
Identification	0.65	0.44	0.68
Suspense	0.70	0.41	0.71
Cognitive mastery	0.28	−0.10	0.19

N = 229; correlations above 0.13 are statistically significant with $p < 0.05$.

previous reading-related flow experiences. As expected based on flow theory and results from general flow research, the RFSS scores showed positive associations to these variables.

Discriminant validity

As can be seen in **Table 4**, Spearman correlations of RFSS flow scores with presence, identification, and suspense scores revealed strong associations between these concepts, and a medium-level association between flow and cognitive mastery. Given that most of the correlations indicate approximately 50% of shared variance, we turned to CFA modeling to test whether flow as measured with the RFSS was still empirically distinguishable from presence, identification, suspense, and cognitive mastery. If that was the case, a multi-factor CFA model with independent clusters and freely correlating latent variables, which includes both items from the RFSS and items assessing one of these other concepts, should show better data-fit than the corresponding unidimensional CFA model; thus, the former CFA model indicates two different latent variables underlying the two measures, whereas the latter indicates a single latent variable.

This assumption was tested for the RFSS paired with presence, identification, suspense, and cognitive mastery, respectively. In a first step, separate CFA models for each concept (for flow see **Figure 1**) were conducted, based on which, in a second step, CFAs for all pairings followed.

As can be seen in **Table 5**, the multi-factor model representing independent clusters for different measures showed better data-fit than the corresponding single-factor model for each construct pairing. Satorra-Bentler corrected scaled χ^2 difference tests confirmed that the multi-factor models indicating separable latent variables significantly outperformed the single-factor models (see **Table 5**).

Criterion Validity

Following the rationale of flow theory, we regressed the RFSS global flow and subscale scores on measures of perceived skills-challenge balance. Since flow theoretically results from optimally balanced skills and challenges, we expected an inverted U-shaped association between the RFSS scores and responses on the items assessing skills and challenge, for which the response scales' midpoints represent optimal balance. We combined RFSS scores into four categories to obtain sufficient data points per category and then conducted a second-order polynomial regression model for ordered categorical outcome variables.

As expected for the global flow score, significant positive linear (coefficient b_1) and negative quadratic (coefficient b_2) effects were found for both items measuring skill-challenge balance (item A: $b_1 = 1.89$, $z = 1.98$, $p = 0.048$, $b_2 = -0.19$, $z = -1.98$, $p = 0.048$; item B: $b_1 = 1.32$, $z = 1.98$, $p = 0.048$, $b_2 = -0.21$, $z = -2.21$, $p = 0.027$). Observations and regression lines are illustrated in **Figure 2**.

For the Absorption subscale score, both linear and quadratic effects were non-significant, while for Smooth Processing, only the quadratic effect for item B gained significance ($b_2 = -0.29$, $z = -2.87$, $p = 0.004$).

DISCUSSION

Against the background of psychometrically limited methods for flow measurement in fiction reading, we developed the RFSS, an 8-item reading-specific flow scale based on a well-established general flow scale, the FSS (Rheinberg et al., 2003), and its componential measurement approach. Our study provides evidence that the RFSS is a useful instrument for assessing flow states in fiction reading. Thus, the scale shows (1) a conceptually adequate factorial structure and good reliability estimates, (2) the predicted relationship with perceived skills-challenge-balance, (3) associations with theoretically flow-related concepts, and (4), on top of substantial convergence, also sufficient distinctness when compared to other concepts of pleasure-related narrative engagement.

In support of a successful adaptation of the FSS, RFSS items loaded on two factors, largely corresponding to the two FSS subscales Absorption and Smooth Processing. However, two items which showed no clear loading pattern had to be discarded. Since item 4 ("I had no problem to concentrate during reading.") comprises both the notion of subjective effortlessness indicating Smooth Processing and of high concentration indicating Absorption, and since item 5 ("My mind was totally clear during reading.") is phrased in a way that allows for various interpretations, cross-loadings are explicable and the decision to remove those items seems justified. Another three items did not load on the same factor as their FSS counterparts.

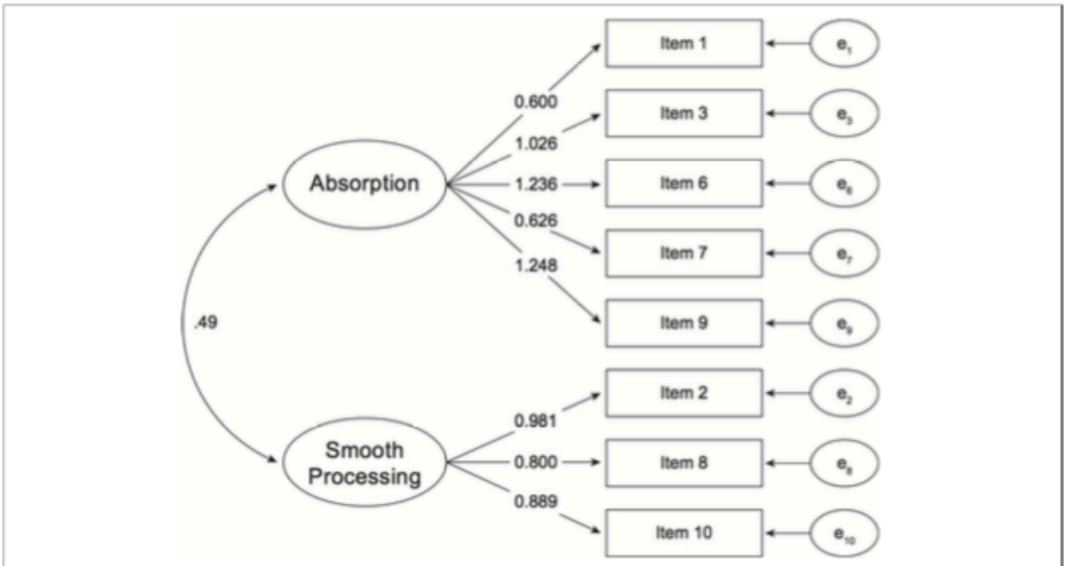

FIGURE 1 | Results of the confirmatory factor analysis for the Reading Flow Short Scale (RFSS). Two latent variables, Absorption and Smooth Processing, explain the variability in item responses; ***$p < 0.001$.

Given that the FSS and RFSS differ both in the domain of application and in item wording, such minor alterations in the factorial structure were to be expected. As a result, however, the RFSS Absorption dimension ended up being over-represented compared to the Absorption dimension on the original FSS. Following Rheinberg and Vollmeyer's (2001) assumption that facets of flow differ in weight across activities, one could speculate that flow in fiction reading is indeed primarily characterized by absorption, while the role of smooth processing is smaller in this context compared to other flow activities.

In any case, smooth processing and absorption flow components are theorized to add up to the specific state of flow (Rheinberg et al., 2003), so that the calculation of a global flow score seems indicated. However, unlike larger multidimensional flow scales (Jackson and Marsh, 1996; Jackson et al., 2008), the original FSS as well as the RFSS show a two-factor structure, which does not allow psychometric testing of a higher-order model involving a second-order factor representative of global flow. Thus, the higher order model is not identified with two first-order factors only, rendering it impossible to provide evidence in favor or against calculating a global flow score. The insufficient data-fit of a single-factor solution supports the multidimensional conceptualization of flow and the calculation of subscale scores, but cannot provide clarification regarding the global flow score. In the absence of clear empirical evidence, the decision to report a global flow score when using the RFSS can only be based on considerations of feasibility and practical application, its widespread use in flow literature, also for the original FSS (Rheinberg et al., 2003), and on empirical indicators such as the correlation between subscales and internal consistency.

To further validate the RFSS, the relationship between flow as measured by this scale and the flow-criterion of perceived optimally balanced challenges was examined. In line with flow theory, readers who perceived their respective text's level of challenge as optimally fitting to their skills scored high on the RFSS in terms of the global flow score, but not in terms of the subscale scores. These results indicate that while absorption and smooth processing independently of one another show different associations to perceived text challenge, the combination of both high absorption and smooth processing, which characterizes a flow state, can only be found for texts that pose a certain, optimal degree of challenge.

A closer examination of this association between skills-challenge balance and the global flow score, however, revealed that flow was also high for texts perceived as slightly less than optimally challenging. This finding could be a methodological artifact, since the corresponding self-reports might suffer from the difficulty to intuitively estimate skills-challenge balance in fiction reading and from potential biases toward a more flattering intellectual self-presentation. On the other hand, flow might indeed not be limited to reading books perceived as optimally challenging only: A meta-analysis of 28 studies found flow to occur mostly, but by no means exclusively under optimally challenging conditions (Fong et al., 2014). In line with this result,

TABLE 5 | Confirmatory factor analyses results and model comparisons for flow and other pleasure-related reading engagement concepts.

Construct	Model	Fit indices					Model comparisons		
		χ^2 (*df*)	*p*	TLI	CFI	RMSEA	$\Delta\ \chi^2$	*df*	*p*
Flow	Two-factor[a]	20.49 (18)	0.365	0.993	0.995	0.008			
Presence	Single-factor	3.04 (3)	0.385	1.000	1.000	0.057			
Identification	Two-factor[b]	26.73 (18)	0.084	0.992	0.995	0.046			
Suspense	Single-factor	4.04 (3)	0.258	0.997	0.999	0.039			
Cognitive mastery	Single-factor	6.68 (8)	0.572	1.001	1.000	0.000			
Flow and presence									
	Three-factor	124.64 (60)	<0.001	0.971	0.977	0.069			
	Single-factor	361.95 (62)	<0.001	0.868	0.895	0.146			
							75.50	2	<0.001
Flow and identification									
	Four-factor	191.13 (97)	<0.001	0.964	0.971	0.065			
	Single-factor	516.76 (103)	<0.001	0.849	0.871	0.133			
							106.03	6	<0.001
Flow and suspense									
	Three-factor	149.83 (60)	<0.001	0.965	0.973	0.081			
	Single-factor	335.51 (62)	<0.001	0.897	0.918	0.139			
							60.96	2	<0.001
Flow and cognitive mastery									
	Three-factor	161.06 (73)	<0.001	0.965	0.972	0.073			
	Single-factor	1262.06 (76)	<0.001	0.548	0.623	0.262			
							157.04	3	<0.001

[a]*Comprising absorption and smooth processing;* [b]*comprising cognitive perspective taking and empathy; TLI, Tucker-Lewis index; CFI, comparative fit index; RMSEA, root-mean-square error of approximation;* $\Delta\ \chi^2$*, test statistic of the Satorra-Bentler corrected scaled* χ^2 *difference test; df, degrees of freedom.*

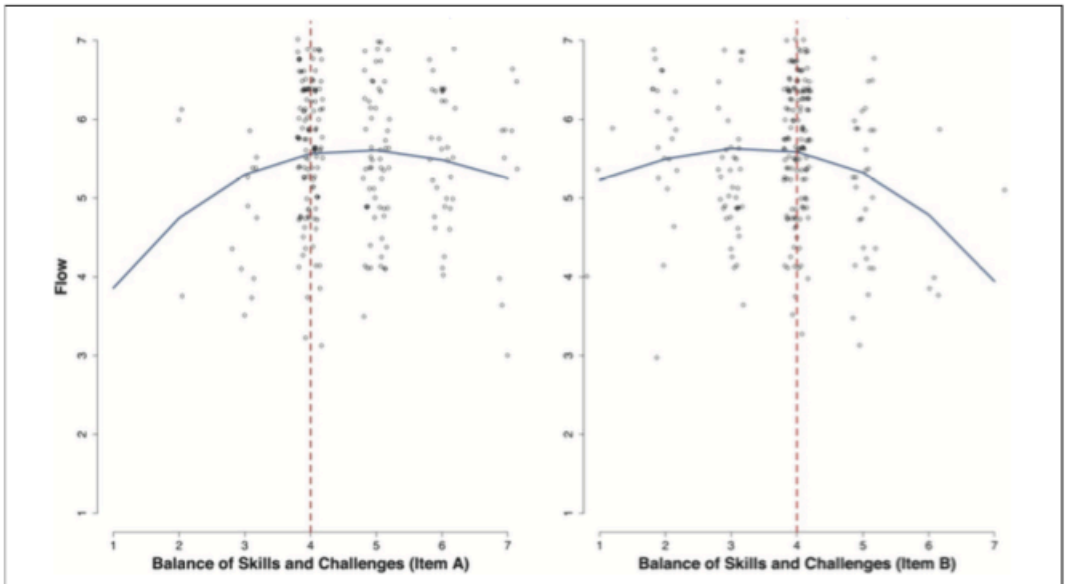

FIGURE 2 | Regression of the RFSS flow scores on balance of skills and challenges. For item A, observations right and, for item B, left of the vertical dashed line indicate perception of low challenge. Individual observations are shown as jittered hollow circles.

the association between flow and optimal challenge levels has been shown to underlie situational and individual influences (Keller and Landhäußer, 2012). Following this rationale, books that pose a less than optimal challenge level on the reader can still be appealing to certain types of readers or become appealing under certain circumstances: For instance, a reader normally interested in challenging material, might pick up and enjoy a young-adult book when reading for relaxation purposes. Whether fiction reading is an activity specifically associated with situations or individuals that facilitate flow experiences under less than optimally challenging conditions, remains an interesting open question for future research.

Based on flow theory and research in other activities, we expected flow in fiction reading to be positively associated with intrinsic reading enjoyment (i.e., Keller and Bless, 2008; Keller and Blomann, 2008), heightened reading-related self-efficacy (Rheinberg et al., 2003), and general affinity toward reading (Csikszentmihalyi, 1975) as well as with a tendency to repeatedly engage in reading (Csikszentmihalyi, 1975). The corresponding correlations obtained in our study were all in the expected direction, as were the correlations between RFSS flow scores and measures of previous reading-related flow experiences. However, correlations were moderate in size. This might result from limited measurement reliability as most concepts were assessed with single-items. Correlations with measures of previous reading-related flow experiences could be particularly affected by methodological limitations, as these measures were based on a description of flow in fiction reading that had not been pre-tested or psychometrically analyzed itself. For most constructs, correlations were higher with Absorption than with Smooth Processing scores. Therefore, it is also possible that global flow score correlations were artificially diminished as a consequence of the smooth processing part of flow being under-represented in the RFSS.

Conversely, correlations between RFSS flow scores and presence, identification, suspense, and cognitive mastery scores were overall high. This was to be expected, as all of the concepts share a strong relationship with reading pleasure. Importantly, CFA modeling empirically confirmed that there is still sufficient distinctness between these concepts within the global reading experience. Thus, flow in fiction reading goes beyond other concepts of pleasure-related narrative engagement, opening a new perspective for reading pleasure research. The high average flow score found in this study supports both the idea of flow being a regular reading state, and of fiction reading promoting flow. Given the close link between flow and intrinsic enjoyment and the comprehensive framework of flow theory, this concept is of considerable added value for research on reading pleasure.

To overcome the limitations of the current study, future research should replicate the psychometric properties of the RFSS with more representative samples of readers and novels. Given that the main aim of the study was to develop a reading-specific flow measure, we deliberately chose to recruit people prone to flow experiences in reading by advertising the online survey in bookstores and amongst literature students. However, this specific sample showed a high educational background and gender bias, so that the current results' generalizability needs to be tested with additional samples. Moreover, future studies should include controlled laboratory conditions and objective measurement approaches. Since retrospective self-report state measures like the RFSS are not free from bias, assessments from other domains, such as psychophysiological or eye-tracking measures, could prove an important complement.

Nevertheless, the RFSS significantly adds to the portfolio of measurement instruments in reading research, as it is the first theoretically derived and psychometrically evaluated measure of flow during fiction reading, opening new perspectives to explore reading pleasure evolvement, be it in leisure, school, or therapeutic contexts. Moreover, the current study's results encourage further investigations of the nature of flow experience in different activity contexts and the possibilities to measure flow with activity-specific scales. By comparing the characteristic pattern of flow components and their interaction in creating an overall flow state across different activities, more insight can be gained about the flow concept in general. Looking into flow states in mental activities emphasizing absorption, such as reading, complements the wide branch of flow research that focuses on motoric or competitive activities emphasizing smooth processing, which will eventually allow for a more complete picture of flow.

ETHICS STATEMENT

This study was carried out in accordance with the recommendations of guidelines and rules of the Max Planck Society. The procedure was approved by the Ethics Council of the Max Planck Society. All subjects gave informed consent in accordance with the Declaration of Helsinki.

AUTHOR CONTRIBUTIONS

BT and WS designed the study. BT collected data, wrote the first draft of the manuscript, and developed and performed the statistical analysis in conjunction with WS. WS and WM reviewed and edited the manuscript and approved the final version of the manuscript.

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Conflict of Interest Statement: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Supplemental Material

Supplement to: Thissen, B. A. K., Menninghaus, W., Kuijpers, M. M., and Schlotz, W. Capturing Optimal Reading Experiences: Flow and Presence in Fiction Reading.

Description of a Flow State in Fiction Reading

Some readers develop a sense of **full engagement with the activity** during reading. They block out themselves, their everyday life, and their surroundings for a while and instead focus completely on reading. They are so concentrated that they lose their sense of time and forget everything around them. It seems as if the readers melt with the story they are reading.

The story, on the other hand, becomes accessible automatically for the reader. Intuitively, the readers understand what the story is about. Neither do they need to actively think about the story content nor do they think about anything else while they are reading. Reading and getting the story does not seem overly demanding, so that the readers feel they could go on reading for hours without problems. They feel that the story is clear, graspable, and entertaining for them and that they are **reading it smoothly and fluently.**

All in all, reading the story is **neither overly demanding nor boring, but optimally challenging** for the readers. They know, that they dispose of the required abilities to empathize with and process the story and that the story is of sufficient quality, so that their reading experience will be entertaining. They enjoy reading the story and are highly motivated to read on and to repeatedly engage in reading in their leisure time.

Such positive mental states during engagement with an activity on an optimal level of demand are known from various other contexts like sports and exercise, playing music, computer gaming, or creating art. In the context of fiction reading, though, little is known about this state. Therefore, in the following you are kindly asked to answer some questions about it.

Please think about whether you have ever felt this way during reading. Think about a personal reading experience that matches the given description of the state as closely as possible, and answer the following questions referring to this reading experience.

Items for Measuring a State of Presence during Fiction Reading

1. When I stopped reading, I felt like I came back to the 'real world' after a journey.
2. During reading, my mind was in the room, not in the story world. (reversed)
3. During reading, my body was in the room, but my mind was inside the world created by the story.
4. The story created a new world, and then that world suddenly disappeared when I stopped reading.
5. At times during reading, the story world was closer to me than the real world.

Items for Measuring Reading Self-Efficacy

1. If I cannot directly connect with a story, I can rely on my abilities to empathize with and wrap my mind around fictional texts.
2. Most novels I start to read, I finish within a relatively short amount of time.
3. I like novels that challenge the reader.
4. I want to develop as a fiction reader and read novels that challenge me.

The Pleasures of Reading Fiction Explained by Flow, Presence, Identification, Suspense, and Cognitive Involvement

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Abstract

The present study proposes that flow is not only a key predictor of the pleasures of reading narratives, but that it also modulates other important dimensions of the fiction reading experience, such as a sense of being present in the story world, identification with protagonists, feelings of suspense, cognitive involvement with the story, and text comprehension. All of these aspects, which until now have mostly been investigated separately, were assessed online for 373 participants after they read a chapter of Homer's Odyssey. To measure flow, we administered an extended and revised reading-specific flow scale. The scale showed good reliability estimates and theoretically expected associations with flow-related constructs and criteria–most notably, with an optimal balance between reader skills and textual challenge. Despite rather high intercorrelations, confirmatory factor analyses demonstrated that flow, presence, identification, suspense, and cognitive involvement constituted distinguishable dimensions within the fiction reading experience. Structural equation modeling confirmed that flow was a key component of the experience. Specifically, it revealed direct effects of flow on presence, identification, suspense, reading pleasure, and text comprehension. In addition, flow yielded a number of indirect effects via these variables, most notably on reading pleasure and comprehension of the story read. To date, the concept of flow plays only a minor role in research on fiction reading. Our results suggest that it deserves being integrated into future theoretical frameworks and empirical investigations of reading pleasure.

Key words: reading pleasure, text comprehension, flow, presence, suspense

The Pleasures of Reading Fiction Explained by Flow, Presence, Identification, Suspense, and Cognitive Involvement

For centuries, readers have turned to literary fiction for the emotionally and aesthetically rewarding experiences it can offer. However, psychological research is only just beginning to understand the interplay of narrative features and mental mechanisms that create what is commonly referred to as reading pleasure. Like most experiences related to the arts, pleasurable reading experiences are highly subjective, dynamic, and complex. Although some efforts have been made to determine the interplay of different experiential dimensions in fiction reading (e.g., Busselle & Bilandzic, 2008; Hamby, Brinberg, & Jaccard, 2016; Jacobs, 2015), a comprehensive model has not yet been achieved. As Tal-Or and Cohen (2010) point out, research on reading faces the challenging task of dissociating various experiential dimensions that frequently co–occur during reading. The most notable experiential reading dimensions are a sense of *presence* (Gerrig, 1993) in the narrative world, *identification* (Cohen, 2001) with story characters, feelings of *suspense* (Zillmann, 1996) in response to story events, and *cognitive involvement* (Kim & Rubin, 1997) with the narrative. Whereas presence is associated with reading pleasure (Busselle & Bilandzic, 2009) through enhancing perceived realism and satisfying the reader's curiosity for other perspectives (Green, Brock, & Kaufman, 2004), identification contributes to reading pleasure by triggering strong emotional responses and involvement (Cohen, 2001). Suspense, in turn, is linked to reading pleasure (Knobloch, Patzig, Mende, & Hastall, 2004) as it (a) caters the reader's need for sensation seeking (Zuckerman, 1971), and (b) may also facilitate a spillover of positive affect, the so-called *excitation transfer*, when the trajectory of tension is finally resolved (Zillmann, 1996). Moreover, the sense of deeply understanding a story during cognitive involvement can increase reading pleasure (Appel, Koch, Scherer, & Groeben, 2002; Knobloch-Westerwick & Keplinger, 2008).

Even though all of these dimensions play a role in the evolvement of reading pleasure, it remains unclear how they might be linked in a comprehensive model of fiction reading. Further complicating matters, the currently most discussed global concepts for positive reading experiences, such as *immersion* (Murray, 1997), *involvement* (Tal-Or & Cohen, 2010), *narrative engagement* (Busselle & Bilandzic, 2009), and *story world absorption* (Kuijpers, 2014), mainly refer to these dimensions only in indirect ways. Moreover, these concepts are in and of themselves problematic given their substantial degree of under-definition and theoretical overlap (Busselle & Bilandzic, 2009).

Against this background, we propose that the concept of *flow* (Csikszentmihalyi, 1975)—as it is comparatively well-defined in regard to its nature and causes—has the potential to integrate different experiential reading dimensions and disentangle their effects and interplay in positive reading experiences. This way, reconsidering established concepts of reading research in light of flow theory can reduce rather than aggravate conceptual confusion in the field. Notably, flow theory further affords a link to the *cognitive fluency* hypothesis of aesthetic enjoyment (e.g., Reber, Schwarz, & Winkielman, 2004), which has received some support also with regard to literature (Bullot & Reber, 2013). Until now, though, flow has not been considered a key concept in reading research, but rather as a loosely related phenomenon from the broader field of motivational psychology. For instance, narrative engagement has been discussed to represent a reading-specific case of a flow state (Busselle & Bilandzic, 2008). However, it remains unclear how flow theoretically relates to other reading concepts.

In the following, we now transfer flow theory and the concept of flow states to the context of fiction reading, discuss its relationship to presence, identification, suspense, and cognitive involvement, and propose a theoretical model of multidimensional positive reading experiences with flow as a key component. We then present a study in which we investigated

the psychometric properties of a detailed reading-specific flow measure and, building on this, our model's adequacy.

Flow

Originally developed in the context of qualitative interviews with painters who display a high level of dedication to their artistic work, the concept of flow describes a person's state of mind when he or she is completely engaged in an activity. Flow theory lines out so-called *flow components* (Csikszentmihalyi, 1975; Jackson & Marsh, 1996; Rheinberg, Engeser, & Vollmeyer, 2003), which together characterize this state and can be adapted to the context of fiction reading in the following way:

(1) *Merging of action and awareness* in the immediate experience of the activity. In flow, a reader's awareness merges with his or her mental model of the story world, supporting a complete immersion in the narrative.

(2) *Focus of attention* on the task at hand. During a flow experience, the reader will fully concentrate on the narrative and temporally withdraw attention from the real world.

(3) *Loss of self-awareness*, also called *self-transcendency*. A reader in flow will put aside considerations about him- or herself in favor of engaging with the thoughts, feelings, and motives of the story characters.

(4) *Altered sense of time,* with time passing either faster or slower than under nonflow conditions. When in flow, the reader will not have a precise idea of the amount of time that has passed since he or she first opened the book.

(5) *Feeling of control* regarding the situation and one's own skills. In the context of flow in reading, this can be restated as a *feeling of competence* in understanding stories and characters.

(6) *Perception of coherent demands* in the sense of compelling, nonconflicting opportunities for action or engagement. Reading in flow will entail a subjective conviction of intuitively understanding the story, without having to ponder about different readings. We use *perception of matching demands* in this context, in order to avoid confusion with *narrative cohesion* as a purely textual property independent of the reader's own skills.

(7) *Sense of clear goals*, in terms of logically ordered aims and the means to achieve them. In the context of reading, this is equivalent to *cognitive schema activation*, which underlies the successful building of a logical, clear mental story model.

(8) *Unambiguous understanding of feedback*, allowing an automated sequence of reactions to task demands. A reader in flow will seamlessly update his or her mental model of the story by integrating feedback about the model's adequacy in the form of new textual information, leading to what we call, in this context, a perceived *ease of cognitive accessibility* of the narrative.

(9) *Intrinsic enjoyment* of the activity. Reading in flow is by definition self-rewarding, resulting in a heightened motivation to continue or repeatedly engage in it.

These various components, which together form "the holistic sensation" (Csikszentmihalyi, 1975, p. 36) that is the flow state, can be subsumed under the concepts of heightened absorption, processing fluency, and enjoyment. Based on this componential conceptualization, flow measurement scales (e.g., Jackson & Marsh, 1996) assess the degree to which individuals have experienced each flow component shortly after their engagement with an activity. A joint flow score is then calculated based on these ratings. In support of the

notion that flow is a multifaceted state, factor analyses of commonly used flow scales suggest multidimensionality with a higher-order flow factor (Jackson & Marsh, 1996).

In order for a person to reach the flow state, the activity in question needs to be optimally stimulating, in the sense that the opportunities for action impose neither too high nor too low a demand on the personal skill level (Csikszentmihalyi, 1975). In the context of fiction reading, this means that the complex interplay of content, composition, and stylistic features which constitute the narrative must match the reader's interests, level of pre-existing knowledge, and reading ability (Sherry, 2004). If this is the case, the reader is able to dynamically apply and expand his or her pre-existing cognitive schemata in conjunction with new textual information (Douglas & Hargadon, 2001), fluently constructing a mental model of the story (Buselle & Bilandzic, 2008). Notably, to experience flow, both processing fluency *and* challenge have to coincide. In a similar manner, higher than usual perceptual fluency *and* increased cognitive demand have been shown to go hand in hand with aesthetic liking of literary stimuli (Menninghaus, Bohrn, Knoop, Kotz, Schlotz, & Jacobs, 2015; Song & Schwarz, 2009). Therefore, flow during reading might be associated with aesthetic appreciation of the text. Across many activity contexts, flow has been found to be associated with enjoyment (e.g., Keller & Bless, 2008; Keller & Blomann, 2008), increased positive affect (e.g., Csikszentmihalyi & LeFevre, 1989; Schüler, 2007), motivation for continued engagement (e.g., Csikszentmihalyi & LeFevre, 1989; Landhäußer & Keller, 2012), activity-related self-efficacy (Rheinberg et al., 2003), and enhanced performance (for an overview, see Landhäußer & Keller, 2012).

Against this background, a contribution of flow to pleasurable reading experiences has been theoretically discussed by various reading scholars (e.g., Busselle & Bilandzic, 2008; Muth, 1996; Weber, Tamborini, Westcott-Baker, & Kantor, 2009). However, some flow researchers have raised doubts that flow should be considered a proper flow activity, as

reading is viewed as being too passive, and not sufficiently clearly focused on achievement (Rankin, Walsh, & Sweeney, 2018). Building on Busselle and Bilandzic's (2008) model of narrative comprehension and engagement, we argue that reading does involves both active engagement and a challenging task, as it requires flexible construction of a mental model of the unfolding story in conjunction with previously acquired knowledge (Weber et al., 2009). To be sure, most flow research focuses on activities that are physically challenging and characterized by externally defined goals. However, the concept of flow can well be extended to activities that involve mental challenges, inner interactions, and self-selected goals (Csikszentmihalyi, 1975; Csikszentmihalyi & LeFevre, 1989; MacDonald, Byrne, & Carlton, 2006). Moreover, preliminary evidence supports the notion that readers indeed experience flow. First, reading emerged as one of the most common flow activities in survey self-reports on flow in everyday life (Massimini, Csikszentmihalyi, & Delle Fave, 1988; Rankin et al., 2008). Second, in the only studies we know of that have administered flow measures in the context of reading, average flow scores were consistently high (Ghonsooly & Hamedi, 2014; McQuillan & Conde, 1996; Shahian et al., 2017; Thissen et al., 2018). These studies also present evidence for links between flow and reading pleasure (Thissen, Menninghaus, & Schlotz, 2018), as well as flow and text comprehension (Shahian, Pishghadam, & Khajavy, 2017). However, the results are preliminary and should be interpreted with caution as the measures employed either did not capture each flow component as required by the componential measurement approach, did not adapt items in a meaningful way to the activity of fiction reading, or showed psychometric limitations (for more details, see Thissen et al., 2018).

Presence

Whereas flow can occur in any activity people actively engage in (Csikszentmihalyi, 1975), engagement with narratives specifically involves entering a story world and imagining

its characters and scenarios. This distinct characteristic of fiction has been addressed through the concept of *presence* (e.g., Busselle & Bilandzic, 2009; Gerrig, 1993; Lee, 2004). Originating from virtual reality studies, presence refers to the subjective sense of being in a fictional environment and perceiving objects or persons in this environment as real in sensory or nonsensory ways, while one's actual surroundings are temporarily blocked from attention (Lee, 2004). In this sense, experiencing narrative presence during reading amounts to a particularly vivid form of mental imagery in the construction of a mental story model (Busselle & Bilandzic, 2009). Given that readers in a state of presence experience an optimal form of imaginative processing and are fully engaged in the story world, presence has theoretically been linked to flow (Tal-Or & Cohen, 2010). Likewise, increased absorption—which is reflected in flow components such as losing self-awareness—has also been discussed as part of the concept of narrative presence (Busselle & Bilandzic, 2009; Kuijpers, 2014). However, absorption during flow refers to activity engagement rather than to a story world. Thus, flow is conceptually distinct from presence in that it is more general and only in certain activity contexts related to mental imagery and sensory perception. In support of this conceptual distinction, psychometric evidence has suggested that flow and presence are distinct dimensions of the reader's experience, despite being strongly related during fiction reading, (Thissen et al., 2018).

Identification

In order to form an adequate mental representation of a story, readers not only need to imagine the story world, but must also adopt the perspective of the story characters (Mar & Oatley, 2008). If successful, these imaginative processes may culminate in an internalization of the characters' thoughts, feelings, and motives, known in reading research as *identification* (Cohen, 2001). Following the understanding of narrative fiction as a simulation of social experiences (Mar & Oatley, 2008), identification can be seen as the highest form of

empathetic engagement on the part of readers, in that readers not only relate to or sympathize with, but actually imagine being the story character (Cohen, 2001). Considering that an elaborate mental story model entails engagement with the story characters, flow during reading may well require identification as part of an optimal reading experience. Specifically, loss of self-awareness during a flow state might facilitate the temporary shift in perspective that underlies identification (Tal-Or & Cohen, 2010). However, the degree to which a reader identifies with a protagonist not only depends on the overall quality of the reading experience, but also on factors such as perceived similarities (Jose & Brewer, 1984) and character judgement (Tal-Or & Cohen, 2010). Similarly, the enhancement of media enjoyment through identification (Cohen, 2001) has been shown to be modulated by factors such as a character's fate in the story or the morality of his or her actions (Tal-Or & Cohen, 2010). Consequently, although identification and flow presumably often coincide, they are assumed to represent distinct dimensions in positive reading experiences, which has recently been confirmed psychometrically (cf. Thissen et al., 2018).

Suspense

The most preeminent reader response associated with fictional narratives is the feeling of *suspense* (Knoop, Wagner, Jacobsen, & Menninghaus, 2016). Suspense involves and negotiates both positive and negative anticipations, and therefore is associated with degrees of uncertainty regarding the narrative's ending or the way the ending comes about (Brewer & Lichtenstein, 1982), with a specific focus on the fate of protagonists whom readers feel for and care about (Hoeken & van Vliet, 2000). Together with the discourse structure, which determines when specific pieces of information are revealed to the reader, the reader's affective disposition—that is, his or her wish to see liked characters ultimately rewarded—accounts for the development of suspense (Zillmann, 1996). Accordingly, suspense shows positive associations with identification (Jose & Brewer, 1984) and plot comprehension

(Knobloch-Westerwick & Keplinger, 2008). Given that suspense serves as a preeminent reading reward and builds on successful cognitive and emotional engagement with the story, flow states during reading might include, and potentially also increase, feelings of suspense.

Cognitive Involvement

A fair amount of a reader's engagement with a narrative occurs in an unconscious and automatic manner, specifically in states of flow. However, a conscious and deliberate form of *cognitive involvement* (Kim & Rubin, 1997) with the text can emerge when the reader ponders the story, attributes deeper or personal meaning to it, and transfers it to his or her own knowledge and memories (Appel et al., 2002). Thus, cognitive involvement goes beyond mere text comprehension in that it refers to a connection of the mental story model with other thought processes. Such reflective responses can occur at multiple stages of a narrative trajectory, adding to the multifariousness of reading experiences. However, episodes of deeper rumination seem unlikely to occur simultaneously with states of flow as they might prevent readers from fully immersing in a narrative (Knobloch-Westerwick & Keplinger, 2008) and partially shift attention away from the construction of a mental model of the story itself. Nevertheless, it seems plausible that elaborate mental story models constructed during flow could facilitate cognitive involvement at a later stage of the reading process.

A Model for Positive Multidimensional Reading Experiences

Integrating flow theory and the aforementioned related dimensions of reading experience into a comprehensive framework, we propose the following model of positive multidimensional reading experiences (see Figure 1 for a graphical depiction).

If a fictional text matches the reader's skills and interests, so that he or she is both capable of and motivated to completely engage with reading, flow during the construction of a mental story model may occur. Flow will then contribute to an optimal reading experience, which results in enhanced reading pleasure and pronounced text comprehension. On the one

hand, flow can increase both outcomes directly as it comprises fluency and absorption in constructing the mental story model. This should not only account for some of the enjoyment that is subsumed under reading pleasure, but also for text comprehension due to elaborate cognitive representations. On the other hand, flow can serve as a mediator between reader variables (i.e., skills and motivation) and dimensions of the reading experience (i.e., presence, identification, and suspense), which then positively affect reading pleasure and text comprehension. Given that the text is intended to trigger presence, identification, and/or suspense in the reader, readers in flow will be particularly likely to experience these reading dimensions due to optimal imaginative, emotional, and cognitive processing of their mental story models. Besides the associations presence, identification and suspense have with flow, they are also assumed to have mutual effects. Specifically, the diminished distance to the fictional world that comes with presence, and the emotional attachment to the protagonists that comes with identification, are assumed to increase feelings of suspense. Given that suspense and identification not only involve an emotional, but also a cognitive component—in terms of understanding discourse structures and protagonists' perspectives—they are expected to increase cognitive involvement. If reading motivation is sufficiently high to deeply engage with the text, emotional investment due to identification and suspense might lead the reader to further expand on cognitive text processing, leading to a more reflective reading approach that cumulates in cognitive involvement. All of these various reading dimensions are assumed to contribute to the experience of reading pleasure as well as to a vivid and elaborate mental story model that results in profound text comprehension. To empirically investigate this set of theoretical assumptions, we conducted a study with two major aims: (1) Develop and psychometrically investigate an extended self-report measure for assessing flow states during reading, and (2) test our integrative theoretical model of reading experiences using structural equation modeling.

Methods

Participants

We recruited participants with bookmarks advertising the online survey in two major bookstores, at public readings, and at Goethe University's Institutes of German Philology and Literature in Frankfurt am Main (Germany). The criteria for participation included a declared capacity to read a longer German text and being at least 18 years old, i.e., of legal age in Germany. For survey completion, participants received an online book voucher worth 12€. Of the initial sample ($N = 452$), we excluded 79 persons from the data analyses due to either careless response behavior (Meade & Craig, 2012) shown in regard to control questions ($n = 22$) or due to an unrealistically fast survey completion time ($n = 57$) of less than 20 minutes, indicating inattentive reading. The final sample ($N = 373$) comprised 242 women (65%) and 127 men (34%) between 18 and 81 years of age ($M = 36.2$, $SD = 15.6$). The majority ($n = 322$; 86%) were native German speakers, and close to half held a graduate degree ($n = 163$; 44%).

Design and Procedure

The survey was set up using Unipark/EFS Survey software and was accessible online from January 18 through April 29, 2018. Participants provided information about their demographics and general reading behavior, read a chapter of Homer's Odyssey, and filled out scales measuring different aspects of their reading experience. They also answered multiple choice questions in order to assess their text comprehension and completed a test for general reader skills. All procedures were ethically approved by the Ethics Council of the Max Planck Society.

Reading Material

Participants read a modern prose text translation (Lempp, 2010) of Book 12 of the Odyssey, in which Ulysses narrates the last part of his eponymous wandering on the journey

home after the Trojan War. This 3,670-word narrative constitutes a self-contained episode with a clear arc of suspense and prototypical narrative structure. Given that the average reader can process up to 250 words per minute (Rayner, 1998), the approximate estimated reading time was 15 minutes. We regarded this amount of time as sufficient for the reading experience to unfold in an ecologically valid way without fatigue effects.

Considering that the Odyssey is a canonical part of Western literature, we expected participants to be familiar with certain elements of the story (e.g., the sirens trying to lure sailors into dangerous waters with their enchanting voices) as well as with its narrative structure (i.e., conflict, resolution, transgression, and punishment), which is characteristic for many folk and fairy tales. On the other hand, the Odyssey is no longer part of today's literary curricula, so that the details of the story (e.g., how Ulysses managed to ultimately withstand the sirens' deadly temptation) were most likely new to our participants. We expected that this synergy of familiar and unknown story elements could increase the likelihood of flow experiences during reading by simultaneously activating and expanding existing cognitive schemata and thus providing an optimal stimulation level. Further substantiating the story's flow potential, its outstanding grip on readers' attention, involvement, and enjoyment has been proven not only through its enduring fame, but also by the innumerable variants through which it has been retold up to the present day. The episode is rich in atmosphere and meaning, so that it has a high potential for leading the reader to not only experience flow, but also multiple other dimensions of positive reading experiences, including: presence due to an atmospheric and metaphoric use of settings (e.g., evocation of a perfect calming of the winds when Ulysses approaches the deadly sirens' island); identification with Ulysses, who is presented as a classical hero in conflict (e.g., he is finally on his way back home to his wife, but is also susceptible to the sirens' charms); suspense resulting from the adventurous plot and the graphic description of dangers (e.g., the sea monsters Scylla and Charybdis); and

cognitive involvement given the complex plotline and the conflicting motivations between which Ulysses has to navigate (e.g., following the divine order not to touch Helios's sacred cattle or succumbing to his starving men).

Measures

Please see Supplement for all items, scales, and a detailed description of the general reader skill test, and Table 2 for the scales' descriptive statistics and reliability estimates.

General reading behavior. Participants indicated how much they generally like to read on a 5-point Likert scale, ranging from *not at all* to *very much*. Their habitual frequency of reading fictional narratives over the year was measured on a 7-point Likert scale, ranging from *(almost) daily* to *never*. For measuring self-efficacy in terms of reading, we developed a four-item scale by adapting items from general self-efficacy scales (Beierlein, Kovaleva, Kemper, & Rammstedt, 2012; Engeser, 2005) to assess individuals' beliefs about their reading comprehension and enjoyment abilities. A reading self-efficacy score was computed by averaging across item responses, which were given on a 7-point Likert scale ranging from *strongly disagree* to *strongly agree*.

General reader skills. To assess their general reader skills, we had participants fill out Schneider, Schlagmüller, and Ennemoser's (2017) Reading Speed and Comprehension Test (Lesegeschwindigkeits- und Verständnistest; LGVT), adapted for online presentation. The LGVT requires participants to fill in gaps in a narrative text with one out of three word-options that best matches the textual context. As the LGVT is a speed test, completion time is limited to 6 min. Scores for *reading accuracy* are computed by dividing the number of correct word choices by the total number of supplied answers and multiplying the result by 100, yielding a general measure of reader skills in terms of the percentage of correct answers. The LGVT has been validated for high-school student populations, but as the authors report no significant competence gain in the norm sample's reader skills above age 16, it appears to

also be applicable to more advanced readers. Consistent with this assumption, the average score distribution (see Table 2) in our sample was slightly higher but still comparable to the average reported for a senior-grade norm sample, with a median of 95.79% as opposed to 90%. The authors report satisfactory retest-reliability of .80 for the reading accuracy score. We, however, could not test its reliability in our study, given that the study design did not involve a second application of the test and other methods of reliability estimation do not apply to the LGVT due to number of supplied answers being critical for the score calculation.

Reading experience.

Reading situation variables. Prior to reading, we provided participants with a short disclaimer about the story and the text type. Participants subsequently rated their familiarity with the story using a binary response format. Moreover, they rated their reading motivation on a 5-point Likert scale, ranging from *not at all* to *very much* motivated. After reading, they rated their liking of the text and their motivation to read another chapter of the Odyssey on identical scales. We also measured participants' perceived balance of skills and challenges using two items adapted from Rheinberg et al. (2003). Specifically, participants were asked to rate their reader skill level in relation to the text as well as the text's level of challenge in relation to their reader skills on 7-point Likert scales ranging from *too low* to *too high*. We added an item in which participants rated their reading experience on a 7-point Likert scale ranging from *boring* to *exhausting*. For all three items, the middle category *just right* indicated a perceived optimal balance of skills and challenges. We calculated the mean score for perceived balance as well as a mean score for perceived optimal balance, the latter by recoding the response scale's midpoint as the maximum.

Presence, identification, suspense, and cognitive involvement. To assess presence, identification, suspense, and cognitive involvement, we administered the Being There subscale, the Similarity Distance subscale, the Suspense subscale, and the Cognitive

Involvement subscale of Appel et al.'s (2002) Reading Experience Scale. Items were presented in randomized order, rated on a 7-point Likert scale ranging from *strongly disagree* to *strongly agree* regarding the immediate reading experience, and averaged to obtain a score for each subscale after reverse coding some of the items.

Flow States. For the purposes of the present study, a detailed and psychometrically sound assessment of flow states during fiction reading was critical. Given that the only published reading-specific flow measure we know of (Thissen et al., 2018) is rather brief and does not adequately represent fluency-related flow components, we opted to develop a new scale by revising and extending the existing one. Our objective was to capture *all* flow components in the specific context of fiction reading, following the componential measurement approach (Moneta, 2012) prevailing in today's flow research. Therefore, we added items to obtain a three-item subscale for each of the nine flow components, resulting in a total of 27 items. Moreover, we rephrased some of the original items and carefully worded the additional items so that they were both clearly based in flow theory and adapted specifically to the reading context. An expert in the field of flow research evaluated and approved the final set of items. We grouped the items into subdimensions for Absorption, Fluency, and Engaged Enjoyment, as these experiential qualities underlie several of the flow components and together form the flow state (Csikszentmihalyi, 1975; Rheinberg et al., 2003). Participants were instructed to answer the items, which were presented in randomized order, by referring to their immediate reading experience on a 7-point Likert scale ranging from *strongly disagree* to *strongly agree*. The new scale was termed Fiction Reading Flow Scale (FRFS) and is shown in Table 1.

Text comprehension. To assess the extent to which readers constructed an elaborate mental model of the story, we developed five multiple-choice questions with four response options each following common guidelines (Haladyna, Downing, & Rodriguez, 2002), which

were presented in a forced-choice format with a randomized order of response options. Participants had to make inferences in order to identify the correct response option, as the answer was not explicitly stated in the text and required in-depth comprehension of the plot, characters, and story world. We calculated a multiple-choice score for each participant by summing the number of correct answers across all five questions.

Statistical Analysis

All statistical analyses were performed using the software program R version 1.1.383 (R Core Team, 2013). Given the highly skewed distribution of responses across reading experience scales, as indicated by visual inspection of histograms and significant Lilliefors test statistics, we used robust methods to conduct our data analysis.

To test the FRFS's construct validity, we conducted a confirmatory factor analysis (CFA) for ordered-categorical indicators. We tested model fit with the weighted mean- and variance-adjusted least squares estimator (WLSMV) based on the polychoric correlation matrix, as recommended for cases of non–normality (Flora & Curran, 2004). For WLSMV estimation, the data fit is considered good if the Tucker-Lewis index (TLI) is above .95, the comparative fit index (CFI) above .96, the root mean square error of approximation (RMSEA) close to .05 or lower, and the standardized root mean square residual (SRMR) below .07 (Yu, 2002). We further tested construct validity by calculating Spearman correlations between the FRFS scores and flow-related concepts such as reading self-efficacy. We tested criterion validity by calculating point-biserial correlations with criteria such as future reading motivation. Additionally, we used second-order polynomial regression models to verify an inverted U-shape association between flow and the perceived balance of skills and challenges, meaning that FRFS scores are expected to peak at the point of perceived optimal balance on the corresponding response scale's midpoint. Given that the distribution of residuals in the quantile-quantile plot was highly skewed and likelihood ratio

tests confirmed the basic proportional odds assumption, which refers to effect consistency across thresholds, we employed ordinal regression analysis. To obtain sufficient data points for each category, we combined the FRFS scores into four categories prior to the regression.

To test the relationship between flow and the other concepts theoretically related to positive reading experiences, we calculated Spearman correlations between flow, presence, suspense, identification, and cognitive involvement scale scores. Moreover, we conducted a global CFA model with all items used, with one latent factor each for presence, identification, suspense, and cognitive involvement in addition to the higher-order flow model. As all items were specified to load on the factor corresponding to the concept they were intended to measure, the model's data fit serves as an indicator for psychometric distinguishability against the background of partial theoretical overlap (e.g., in terms of absorption). To further gain insight into how the different concepts interplay in evoking reading pleasure and supporting text comprehension, we tested a structural equation model (SEM) based on the theoretically assumed associations between the concepts, using ordered categorical indicators and the robust WLSMV estimator. Kruskal-Wallis tests revealed that background variables like gender, age, educational level, being a native or nonnative speaker, and familiarity with the story had few systematic effects on the variables included in the SEM model: We found significant group differences for familiarity with the story in terms of reading motivation ($\chi^2(1) = 17.320, p > .001$), cognitive involvement ($\chi^2(1) = 7.516, p = .006$), and reading pleasure ($\chi^2(1) = 6.898, p = .009$). Moreover, a significant group difference emerged for educational background and cognitive involvement ($\chi^2(7) = 15.687, p = .028$). Therefore, we entered these background variables as predictors into the SEM model to adjust for their potential effects.

Results

The Fiction Reading Flow Scale (FRFS)

Reliability. Reliability estimates of the FRFS scale are shown in Table 2, and those for FRFS's subscales in Figure 2. Both, the FRFS total scale as well as the subscales, showed satisfactory reliabilities.

Validity analysis.

Construct validity. Based on the theoretical conceptualization of flow as a holistic state that comprises different components on certain subdimensions, we tested an independent-cluster CFA model with the nine flow components as first-order factors, Absorption, Fluency, and Engaged Enjoyment as second-order factors, and Flow as an overarching third-order factor (see Figure 2). This model involved one minor modification that allowed free covariance between the Altered Sense of Time factor and item 18, given the temporal reference in this item. Item coefficients in Table 1 and fit indices in Table 3 suggest a good fit of this model. In addition to the FRFS having the expected factor structure, construct validity was supported by significant positive correlations of the scale's flow score with the following theoretically flow-related constructs: reading pleasure, motivation before reading, perceived optimal skills–challenge balance, performance on the text comprehension questions, general reading affinity, frequency of reading novels, reading self-efficacy, and reading accuracy as an indicator of general reader skills (see Table 2). Notably, correlation between flow and reading pleasure remained high (r = .64) even when the mean flow score was calculated without the items assessing Intrinsic Enjoyment.

Criterion validity. Providing evidence for criterion validity, the point-biserial correlation between the FRFS score and motivation to read another Odyssey chapter was substantial and statistically significant (r_{pb} = .56). Moreover, regression analysis confirmed the expected inverted U-shaped association between the FRFS flow score and the mean perceived balance of skills and challenges, as indicated by significant positive linear (b_1 = 3.45, z = 4.57, p < .001) and negative quadratic (b_2 = -0.48, z = -4.69, p < .001) regression

coefficients. Importantly, both coefficients remained significant even when the flow score was computed without the Perception of Matching Demands items, which might significantly contribute to the association ($b_1 = 3.19, z = 4.29, p < .001$; $b_2 = -0.44, z = -4.42, p < .001$).

Multidimensional Reading Experiences

Intercorrelations. The mean scores for flow, presence, identification, suspense, and cognitive involvement while reading the Odyssey chapter were all above the response scales' midpoints, indicating that on average, participants experienced all of these different dimensions of positive reading experiences in our study. Table 2 shows strong correlations between the dimensions, with flow during reading being most closely associated with presence and suspense. Given that the effect sizes indicate between approximately 30% and 60% of shared variance, we proceeded to test the dimensions' distinguishability.

Distinguishability. As can be seen in Table 3, the global CFA model involving flow, presence, identification, suspense, and cognitive involvement yielded an acceptable fit to the data. Thus, items assessing a particular concept loaded on the theoretically defined latent factor.

Structural equation model. Figure 3 shows the SEM model after nonsignificant paths were removed from the hypothesized model. The fit indices suggest an acceptable fit ($\chi^2(1,185) = 2,815.08, p < .001$; TLI = .964; CFI = .962; RMSEA = .061, 95% CI [.058, .064]; SRMR = .059), which did not significantly differ ($\chi^2_{diff}(4) = 6.56, p = .16$) from the original model's fit including all hypothesized paths (Figure 1). Given that it explained the data just as well, we chose to adopt the more parsimonious model. In accordance with the originally hypothesized model, flow during reading was associated with both exogenous variables, reading motivation and reader skills. Together, these variables explained 25% of the variance in flow, with motivation being the stronger influence. As expected, flow in turn explained major variability in presence (73%), identification (58%), and—both directly and

indirectly (i.e., together with presence and identification)—in suspense (86%). The remaining experiential dimension, cognitive involvement, was only indirectly affected by flow, but directly affected by reading motivation and suspense, which together explained 61% of its variance. Concerning the outcome variables, reading pleasure was positively influenced by flow, suspense, and reading motivation, and negatively by presence, identification, and cognitive involvement. Text comprehension was positively influenced by flow and reader skills, on the one hand, and negatively influenced by presence, on the other. Together, the predictor variables explained 60% of the variance in reading pleasure and 18% of the variance in text comprehension. Notably, flow was a central and strong predictor for both outcomes. Moreover, all indirect effects of flow in the model were statistically significant (see Table 4 for details).

Given that the zero-order correlation coefficients were all positive (see Table 2), the negative relationships between reading pleasure and presence, identification, and cognitive involvement as well as between text comprehension and presence meet the criteria for cases of *negative suppression* as defined by Darlington (1968). Following this definition, negative suppression occurs if two variables display a positive bivariate relationship, but at the same time, when one is regressed upon the other and a suppressor variable is entered into the model, a negative estimate emerges. This is due to the suppressor explaining variance in the predictor that is irrelevant for the outcome, therefore revealing the true nature of their relationship when these influences are controlled for (Maasen & Bakker, 2001) and increasing the model's predictive validity (Conger, 1978). In order to test the occurrence of this phenomenon within the complex framework of an SEM model, we identified potential suppressors for each unexpectedly negative path. We then tested whether the exclusion of the path between the potential suppressor variable and the outcome resulted in the path coefficients between the other predictors and the outcome no longer being negative. In this

case, the variable in question was considered to be a suppressor given that it demonstrably affected the way the model explains variance in the outcome in accordance with Darlington's definition of negative suppression.

We opted to test flow and suspense as potential suppressors by replicating our model without the paths between the outcomes and either flow, suspense, or both flow and suspense. Given that flow and suspense had direct effects on both the outcomes and the other predictors—and therefore act as central mediators in the model—they represent the most likely candidates for generating negative suppression effects. When the paths between flow and both outcome variables were removed, the association between presence and text comprehension indeed switched from negative to positive ($\beta = .17, p < .001$), but the negative associations between each presence, identification, and cognitive involvement with reading pleasure remained unaffected. These negative associations changed substantially only when both the paths between flow and reading pleasure and the path between suspense and reading pleasure were removed from the model (presence: $\beta = .13, p < .05$; identification: $\beta = .45, p < .001$; cognitive involvement: $\beta = .01, p = .885$). Therefore, flow can be seen as a negative suppressor for the effect of presence on text comprehension, and both flow and suspense together appear to underlie the negative suppression effects with regard to reading pleasure.

Discussion

In an effort to provide an integrative theoretical framework for positive multidimensional reading experiences, this study presents evidence for (1) flow states to occur during fiction reading, based on a detailed reading-specific flow scale, and for (2) their key role in positive multidimensional reading experiences. The study provides a new perspective on fiction reading by transferring flow theory (Csikszentmihalyi, 1975) and the different absorption-, fluency-, and enjoyment-related components of the flow state to the

specific context of reading. Thereby reading is conceptualized as an active construction of mental story models, in which flow is defined as the experience of an optimal level of stimulation, based on balanced text demands and reader skills. Given our participants' high mean scores on the FRFS, flow was confirmed to be an integral element of their reading experience. As indicated by FRFS items loading on a latent variable for flow rather than on those for presence, identification, suspense, or cognitive involvement, flow serves as an independent, experientially distinguishable dimension within this experience. Strong positive correlations between flow and the other dimensions, most notably presence and suspense, but also with overall reading pleasure, support the notion that positive reading experiences are multidimensional and closely related to flow states. The model we presented for such reading experiences provided a good data fit and explained substantial variance in both reading pleasure and text comprehension. In the model, flow directly predicted presence, identification, and suspense, indirectly predicted cognitive involvement, and among these concepts emerged as the strongest predictor for the two outcome variables.

Measurement of Flow in Fiction Reading

As a means for providing evidence for flow states during fiction reading, we developed the FRFS, a self-report measure assessing all flow components in their reading-specific form. This 27-item scale, based on the componential measurement approach common in flow research (Moneta, 2012) and on a previous short scale (Thissen et al., 2018), showed good reliability estimates, a conceptually adequate factorial structure, and the expected associations with related constructs and criteria. Thus, our findings suggest that the FRFS is a useful instrument for reading research, both for the global assessment of flow and for a fine-grained assessment of its components.

Although the FRFS's factorial structure, involving Absorption, Fluency, and Engaged Enjoyment as second-order factors and Flow as an overarching third-order factor, yielded a

good overall data fit, the RMSEA fit index was higher than the predefined cut-off criterion. However, for complex higher-order models, such a finding is not uncommon and is considered acceptable if the fit indices are otherwise appropriate (Hu & Bentler, 1998), which was the case in our study. As a cautionary note, fit index cut-off values for WLSMV estimation and ordered categorical data remain a topic of ongoing scientific debate (e.g., Garrido, Abad, & Ponsado, 2016), particularly for nonnormality. Nevertheless, based on prevailing recommendations (Yu, 2002) as well as established standards for normally distributed data (Hu & Bentler, 1998), the hypothesized factor structure seems to fit the data well enough to support construct validity. Strong positive associations between the FRFS flow score and measures of motivation to seek repeated exposure, liking, performance, and self-efficacy in reading further supported construct and criterion validity. Criterion validity was also confirmed by the expected association between flow and perceived optimal stimulation, although relatively high flow scores were observed in some of the participants who rated textual demands as slightly below their reader skill level, which replicates findings from an earlier reading study (Thissen et al., 2018). Even though methodological issues might come into play here such as a bias to intellectually present oneself in a flattering way or difficulties in rating textual demands with no direct comparison and various aspects to be considered (Landhäußer & Keller, 2012), our results suggest that flow in reading may not be as closely linked to the perception of optimal challenge as it is in other, more achievement-related flow activities.

The Role of Flow in Multidimensional Reading Experiences

In line with our theoretical model, flow emerged as a central component of positive multidimensional reading experiences. Flow directly and indirectly explained variance in all other dimensions, including presence, suspense, identification, and cognitive involvement, as well as in the outcome variables, namely reading pleasure and text comprehension (Figure 3).

Even though we did not measure the process of constructing mental story models itself, it seems plausible to assume that its fluent execution underlies the positive effect of flow on other dimensions of the reading experience. Thus, during optimal engagement in flow, readers should be able to construct highly elaborate mental story models, which could then serve as the basis for a variety of experiential reading dimensions. For instance, a mental model involving vivid representations of settings and characters could lead to an intensified sense of presence in the story world. Our theoretical model of associations between these variables was largely supported by the data, with one notable exception: Contrary to our expectation, identification had no direct effect on cognitive involvement. One could speculate that the content of the story is the crucial factor to consider here. In the Odyssey episode used in this study, Ulysses suffers a negative fate, which is assumed to elicit stronger negative feelings in those readers who identified with him. Depending on individual coping strategies with negative affect, some persons might refrain from getting cognitive involved under such circumstances, whereas others might be especially prone to do so, yielding a net zero association between identification and cognitive involvement. In contrast, the associations between suspense or reading motivation and identification seem to be less dependent on affective valence of the story as these concepts bear a clearer reflective component (e.g., inferring potential story outcomes, interest) that directly links them to cognitive involvement.

Regarding reading pleasure as a potential outcome of the reading experience, flow emerged as the strongest positive influence, along with suspense and reading motivation, whereas presence, identification, and cognitive involvement turned out to have negative effects on reading pleasure. However, both positive zero-order correlations and results from pruned models indicated that negative suppression accounts for the latter findings. Specifically, flow during reading the Odyssey chapter in our study seems to account for parts of the variance in presence and identification contributing to reading pleasure. This would be

consistent with the notion that flow during the process of imagining the story world or taking the protagonist's perspective is enjoyable by itself. The remaining fraction of the variance in both presence and identification, though, seems to negatively affect reading pleasure, which we primarily attribute to our choice of text. The Odyssey episode read by our participants involves graphic depictions of violent and threatening situations (e.g., Ulysses' encounters with the sirens and with the deadly sea monsters Scylla and Charybdis). A high sense of presence in connection with such scenarios might actually diminish enjoyment by reducing the perceived fictionality and cognitive schema-based distance, thereby supporting a vicarious experience (Bartsch & Viehoff, 2010) of negative story elements. Similarly, a high degree of identification with Ulysses, who goes through sustained ordeals on his way home and ultimately loses all of his companions, may reduce reading pleasure due to a vicarious experience of negative emotions (Bartsch & Viehoff, 2010) and dissonance with the affective disposition (Zillmann, 1996) to see the hero of the story win. However, when the reader also feels suspense, the negative affect associated with presence and identification can be reframed into a positive experience due to mechanisms like sensation seeking and excitation transfer (Knoop et al., 2016; Menninghaus, Wagner, Hanich, Wassiliwizky, Jacobsen, & Koelsch, 2017; Zillmann, 1996; Zuckerman, 1971). Therefore, flow and suspense together appear to suppress those parts of the variance in presence and identification that are positively associated with reading pleasure in our model, while the remaining covariance is presumably highly affected by specific characteristics of the text being read.

For cognitive involvement, our results imply a similar case of negative suppression. Thus, the significant association with reading pleasure disappeared when direct effects of flow and suspense on reading pleasure were removed from the model. Apparently, both flow (indirectly) and suspense (directly) might have prompted a more reflective approach to the text. Due to its negative story elements (such as the fatal attraction exerted by the sirens or

the deadly desire of his companions for the forbidden cattle), this could lead to reduced reading pleasure. Enjoyment of cognitive involvement in itself depends on various factors (e.g. need for cognition; Knobloch-Westerwick & Keplinger, 2008), which may explain why the residual variance had no clear association with variance in reading pleasure. This finding is consistent with our theoretical considerations about cognitive involvement being conceptually distinct from other reading dimensions more closely related to immediate experiences of the narrative.

With regard to text comprehension as another potential outcome of positive reading experiences, flow again turned out as a key factor, even more so than general reader skills. This observation raises the question of whether and to what extent flow experiences in reading might help people with limited reading skills better understand text information by supporting an elaborate mental story model. In contrast to flow, presence showed a negative association with text comprehension in our model, which we once more attribute to a negative suppression effect. Here, the shared variance between presence and flow—likely reflecting their shared conceptual component of absorption—appears to contribute positively to text comprehension, presumably due to their contribution to an elaborate mental story model. However, flow is assumed to lead to absorption in the mental story model's construction and to facilitate processing fluency. In contrast, presence is thought to be a primarily imaginative and immersive phenomenon that lacks an equivalent link to cognitive performance (Lee, 2004). Consequently, the proportion of variance unique to presence could affect text comprehension differently than the variance overlapping with flow, in this case yielding a negative covariance with text comprehension. This might be due to a general process where reflective processes are less elaborate during experiences of presence, as readers may get too caught up in the story world to enable drawing global conclusions about the narrative simultaneously. However, the negative effect of presence on text comprehension

might also be specific to the text used here, as being caught up in a story world full of dangers and threats might particularly strongly interfere with the allocation of cognitive resources to other aspects of the narrative.

The occurrence of such suppression effects in our model implies that the different dimensions of fiction reading experiences are considerably interdependent and need to be studied together in order to draw valid conclusions. The seemingly paradoxical finding of positive bivariate relationships, but negative relationships in SEM modeling, can be understood as a gradual approximation to the complexity of reading experiences, at least for the specific text used in this study. The observed suppression effects suggest all the more that reading experiences are highly versatile and individual and that the role of specific reading concepts in them is intricate rather than per se positive or negative. Our results suggest that without considering the interplay of various experiential dimensions, the prediction of outcomes of fiction reading will be incomplete and inaccurate. Our results also support the notion that flow is one of the key mediating variables to consider in this complex interplay. One could even speculate that flow may stand out as having a distinctly positive effect irrespective of the more text-specific effects of other dimensions of the reading experience. In any case, our findings support the conceptualization of fiction reading as a multidimensional experience in which flow can play a major role as a catalyst for various other experiential dimensions.

The findings of this study are, however, limited by the fact that they were obtained from a sample of self-selected, avid readers and are based on responses to a single text stimulus. The significance of predictors and even the direction of their effects may well be different for other narratives. Even though we cannot expect that our results readily generalize to fiction reading at large, they might, however, be applicable to other reading situations that involve narratives eliciting similarly negative or mixed emotions. In order to

test this hypothesis, as well as to investigate the interaction of flow and other experiential reading dimensions in different reader populations and with other narratives, more research is needed. We are confident that the model we propose in this paper can provide a good starting point for future studies aimed at further disentangling the interplay of different dimensions in fiction reading.

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Table 1

Standardized and Unstandardized Coefficients for Confirmatory Factor Analyses of the Fiction Reading Flow Scale

Subdimension	Item	Latent Construct	β	*B*	*SE*
Engaged Enjoyment	1. Images, ideas and feelings came to my mind on their own while reading.	Flow MA	.79	1.00	-
	2. The story came to life for me in my mind while reading.	Flow MA	.87	1.10	.040
	3. I felt immersed in the story while reading.	Flow MA	.84	1.07	.039
	4. Reading put me in a pleasant state.	Flow IE	.85	1.00	-
	5. I liked reading the story.	Flow IE	.89	1.04	.023
	6. I would have liked to continue reading the story.	Flow IE	.83	.98	.022
Absorption	7. I was completely absorbed in reading.	Flow FA	.89	1.00	-
	8. While I was reading I hardly took notice of what was going on around me.	Flow FA	.79	.89	.025
	9. My thoughts were riveted on the story.	Flow FA	.84	.94	.026
	10. I was completely oblivious while reading.	Flow LS	.88	1.00	-
	11. Things which normally occupy me disappeared from my thoughts while reading.	Flow LS	.81	.91	.029
	12. My own life took a back seat while reading.	Flow LS	.78	.88	.029
	13. I lost the sense of time while reading.	Flow ST	.80	1.00	-
	14. Time stood still for me while reading.	Flow ST	.92	1.16	.045
	15. I find it difficult to say how long I have been reading.	Flow ST	.49	.62	.052
Fluency	16. Reading this story went smoothly and fluently for me.	Flow FC	.74	1.00	-
	17. I would have readily continued reading for a long time.	Flow FC	.71	.95	.053
	18. For me it was no hassle to read the story.	Flow FC	.71	.96	.042
	19. I felt optimally engrossed while reading.	Flow MD	.74	1.00	-
	20. It felt as if the story had been written just for me to read.	Flow MD	.90	1.23	.043
	21. The story suited me well as a reader.	Flow MD	.85	1.16	.046
	22. I had an immediate connection to the story while reading.	Flow SA	.82	1.00	-
	23. I naturally slipped into the story while reading.	Flow SA	.83	1.00	.028
	24. I was able to spontaneously get the gist of the story while reading.	Flow SA	.81	.98	.033
	25. While I was reading I intuitively understood the story.	Flow CA	.80	1.00	-
	26. I knew while I was reading what the point of the story was.	Flow CA	.65	.82	.051
	27. I had no problem to follow the story while reading.	Flow CA	.86	1.07	.033

Note. MA= Merging of Action and Awareness Subscale; IE = Intrinsic Enjoyment Subscale; FA = Focus of Attention Subscale; LS = Loss of Self-Awareness Subscale; ST = Altered Sense of Time Subscale; FC = Feeling of Competence Subscale; MD = Perception of Matching Demands Subscale; SA = Cognitive Schema Activation Subscale; CA = Ease of Cognitive Accessibility Subscale; β = standardized coefficient; *B* = unstandardized coefficient; *SE* = standard error.

Table 2

Summary of Spearman Correlations, Means, and Standard Deviations for Scores on Reading Experience, General Reading Behavior, and General Reader Skills

Measure	1	2	3	4	5	6	7	8	9	10	11	12	13	*Mdn*	*M*	*SD*	*ω*
Reading Experience																	
1. Flow (FRFS)	–	**.76**	**.61**	**.79**	**.52**	**.66**	**.44**	**.32**	**.20**	**.23**	**.23**	**.32**	**.15**	5.11	5.00	1.17	.93
2. Presence (RES-BT)		–	**.59**	**.69**	**.55**	**.50**	**.34**	**.27**	.06	**.14**	**.12**	**.21**	.05	4.60	4.45	1.62	.93
3. Identification (RES-SD)			–	**.65**	**.44**	**.40**	**.23**	**.21**	**.11**	.08	.06	**.19**	**.12**	5.00	4.98	1.34	.77
4. Suspense (RES-S)				–	**.53**	**.62**	**.36**	**.36**	**.12**	**.17**	**.15**	**.19**	**.17**	5.40	5.12	1.34	.87
5. Cognitive Involvement (RES-CI)					–	**.40**	**.37**	**.19**	.05	**.16**	**.12**	**.22**	.10	4.00	4.02	1.16	.68
6. Reading Pleasure						–	**.48**	**.32**	**.18**	**.14**	**.11**	**.15**	**.10**	4.00	4.04	.86	–
7. Reading Motivation							–	.09	.04	**.25**	**.13**	**.21**	.06	4.00	3.90	.89	–
8. Optimal Skill Challenge Balance								–	-.07	.04	.08	-.02	.01	3.33	3.30	.61	.71
9. Text Comprehension									–	.06	.06	-.01	**.28**	3.00	3.16	1.20	–
General Reading Behavior																	
10. Reading Affinity										–	**.51**	**.49**	.05	5.00	4.57	.66	–
11. Reading Frequency Novels											–	**.34**	.07	6.00	5.36	1.66	–
12. Reading Self-Efficacy												–	.02	5.75	5.51	.98	.63
General Reader Skills																	
13. Reader Skills (LGVT)													–	95.79	94.07	5.88	–

Note. N = 373. FRFS = Fiction Reading Flow Scale; RES-BT = Being There Subscale of the Reading Experience Scale; RES-SD = Similarity Distance Subscale of the Reading Experience Scale; RES-S = Suspense Subscale of the Reading Experience Scale; RES-CI = Cognitive Involvement Subscale of the Reading Experience Subscale. For measures 1 to 5 and 11 to 12 the response scale maximum is 7, and for measures 6, 7, 9, 10, and 15 the response scale maximum is 5; for Optimal Skill Challenge Balance the maximum score is 4, and for LGVT Reading Accuracy it is 100. For all scales, higher scores are indicative of more extreme responses in the direction of the construct assessed. Bold print indicates a statistically significant correlation with a p-value of less than .05. ω = reliability estimate McDonald's omega.

Table 3

Confirmatory Factor Analysis Results and Model Comparisons for Flow, Presence, Identification, Suspense, and Cognitive Mastery

Construct	Model	Fit Indices					
		χ^2 (*df*)	*p*	TLI	CFI	RMSEA [CI]	SRMR
Flow [a]	Higher-order model	1191.1 (311)	< .001	.962	.967	.087 [.082; .092]	.046
Presence [b]	Single factor	1.0 (3)	.797	1.000	1.000	< .001 [.000; .056]	.002
Identification[c]	Single factor	-	-	-	-	-	-
Suspense [b]	Single factor	7.4 (3)	< .001	.997	.999	.062 [.000; .121]	.011
Cognitive Mastery [b]	Single factor	5.1 (3)	< .001	.989	.997	.043 [.000; .106]	.017
Global Reading Experience[d]	Higher-order model	2670.8 (916)	< .001	.955	.959	.072 [.069; .075]	.052

Note. [a] Model involving nine first-order factors (Merging of Action and Awareness, Intrinsic Enjoyment, Focus of Attention, Loss of Self-Awareness, Altered Sense of Time, Feeling of Competence, Perception of Matching Demands, Clear Cognitive Schema Activation, and Ease of Cognitive Accessibility), three second-order factors (Absorption, Fluency, and Engaged Enjoyment), and one third-order factor (Flow), including one modification.

[b] Model involving a single factor for the corresponding concept, including two modifications.

[c] Model involving a single factor for the corresponding concept, just identified as measured by 3 indicators.

[d] Model involving Flow, Presence, Identification, Suspense, and Cognitive Mastery as separate correlated latent variables, including modifications.

TLI = Tucker-Lewis index; CFI = comparative fit index; RMSEA = root mean square error of approximation; SRMR = standardized root mean square residual; *df* = degrees of freedom.

Table 4

Standardized Parameters of Indirect Effects of Flow in the Proposed Model of Reading Pleasure as a Multidimensional State

Dependent Variable	Mediator(s)	Indirect Effect
Suspense	Presence	.17***
	Identification	.21***
Cognitive Involvement	Suspense	.36***
	Presence, Suspense	.12***
	Identification, Suspense	.15***
Text Comprehension	Presence	-.39***
Reading Pleasure	Presence	-.37***
	Identification	-.21***
	Suspense	.31***
	Suspense, Cognitive Involvement	-.06*
	Presence, Suspense, Cognitive Involvement	-.02*
	Identification, Suspense, Cognitive Involvement	-.03*

Note. *$p < 0.05$. **$p < 0.01$. ***$p < 0.001$.

Figure 1. Theoretical Model of Reading Pleasure as a Multidimensional State

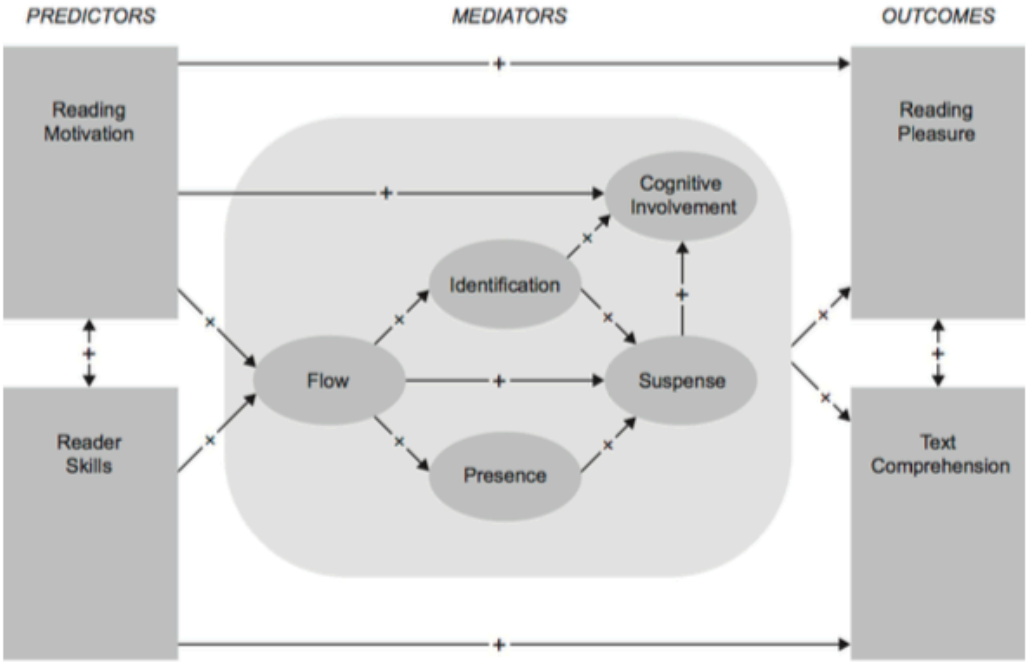

Figure 1. The model depicts the expected relationships between reader variables (predictors), flow and text-specific positive facets of fiction reading (mediators), and reading pleasure as well as text comprehension (outcomes). As indicated by the plus signs, all relationships were expected to be positive.

Figure 2. Results of the Confirmatory Factor Analysis for the Fiction Reading Flow Scale

Figure 2. Nine first-order factors, three second-order factors, and one first-order factor explain the variability in item responses. Reliability estimates for the scale and each subscale are in parenthesis; ω = McDonald's omega. ***$p < 0.001$.

Figure 3. Resulting Model of Reading Pleasure as a Multidimensional State

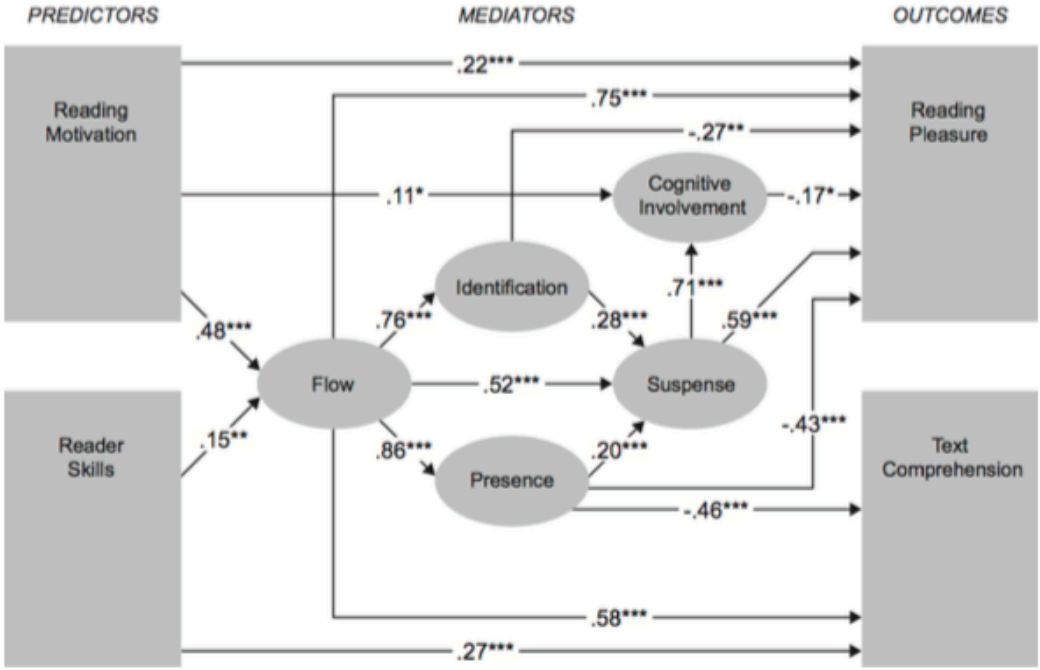

Figure 3. The model depicts the resulting relationships between reader variables (predictors), flow and text-specific positive facets of fiction reading (mediators), and reading pleasure as well as text comprehension (outcomes). Indicator variables are omitted and standardized parameters are shown. $^{**}p < 0.01$. $^{***}p < 0.001$.

Supplemental Material

Supplement to: The Pleasures of Reading Fiction Explained by Flow, Presence, Identification, Suspense, and Cognitive Involvement

Measures employed in the study (see subsection *Measures* in the *Method* section)

1. General reading behavior

1.1 Reading affinity
(single-item; response format: 5-point Likert scale, ranging from not at all *to* very much*)*

How much do you like to read?

1.2 Reading frequency for novels
(single item; response format: 7-point Likert scale, ranging from (almost) daily *to never)*

How frequently do you normally read novels or narratives?

1.3 Reading self-efficacy
(Self-developed scale; response format: 7-point Likert scale, ranging from strongly agree *to* strongly disagree*)*

If a book interests me, I do not care whether it is hard to read.

If a book interests me, I read it even if it is a long story.

If I cannot directly relate to a story, I can rely on my ability to empathize and understand texts.

Most books I start reading, I finish within a short time span.

2. General reading skills

(Schneider, Schlagmüller, and Ennemoser's (2017) Reading Speed and Comprehension Test (LGVT); response format: one correct and two false response options to choose from according to textual context per gap)

The LGVT consists of a gap text, of which participants should read and fill out as much as possible in 6 minutes time. Participants are instructed to read as fast and accurately as they can. In order to pick the correct one from the three response options that are presented with each gap, participants have to understand the textual context and identify the best match. An example item refers to the height of giraffes and then involves a gap, where the text says up to which height the trees have barely any leaves left when a group of hungry giraffes has past. By combining the information given beforehand in the text (the giraffes' normal height) and logically applying it to the gap (the highest height from which the giraffes can pick leaves has to be roughly equal to their own height), participants can find the correct response. Given that the LGVT is a speed test and the gap text is fairly long, most participants are not able to fill in all gaps in the given time. Based on the number of correct and missing responses, scores on reading speed, comprehension, and accuracy can be calculated. For the purposes of this study, we obtained reading accuracy scores to operationalize general reader skills.

3. Reading experience

3.1 Reading situation variables

3.1.1 Familiarity with the text

(single item; response format: binary, yes or no)

You will now read a chapter of the *Odyssey*, called book 12. In this chapter, Ulysses narrates the last part of his long and arduous wandering. At the beginning of the chapter, he and his companions have just returned to the island of the sorceress Circe, after they had managed to come back alive from Hades, the realm of the dead. Circe, who had sworn to help Ulysses, warns him about more dangers that will await him.

Are you familiar with the plot of book 12 of the *Odyssey*?

3.1.2 Reading motivation

(single item; response format: 5-point Likert scale, ranging from not at all *to* very much*)*

The story you are about to read is a chapter from a modern prose translation of the *Odyssey*. The *Odyssey* is a heroic tale from Ancient Greece. It narrates the story of Ulysses, king of Ithaca, whose ships get lost on their way back home from the Trojan War. Ulysses encounters giants, sorceresses, and monsters and has to overcome many dangers – sometimes with the help of gods, sometimes thanks to his own wits – before he can return home to his family and his people.

How much would you like to read this text?

3.1.3 Reading pleasure

(single item; response format: 5-point Likert scale, ranging from not at all *to* very much*)*

How much did you enjoy reading this *Odyssey* chapter?

3.1.4 Optimal skills and challenge balance

(Items 1 and 2 adapted from Rheinberg, Engeser, and Vollmeyer (2003), item 3 self-developed; response format: 7-point Likert scales ranging from too low *to* too high *for items 1 and 2 and from* boring *to* exhausting *for item 3, with* just right *as the middle category indicating optimal stimulation)*

For me personally, the text demands this story poses on the reader are…

I think in regard to this story my reader skills are…

To me, reading this story was…

3.1.5 Motivation to read another chapter

(single item; response format: binary, yes or no)

Would you like to read another chapter from the *Odyssey* in the future?

3.2 Presence, identification, suspense, and cognitive involvement

3.2.1 Presence

('Being There' subscale of Appel, Koch, Scherer, and Groeben's (2002) Reading Experience Scale (RES-BT); response format: 7-point Likert scale ranging from strongly disagree *to* strongly agree*)*

While I was reading I felt completely immersed in the story world.

Reading was like taking a journey to somewhere else.

While I was reading I had the feeling that I was in another world.

I had the feeling that I was in the world that had been described.

My body was here in the room but I was in the story.

3.2.2 Identification

('Similarity Distance' subscale of Appel, Koch, Scherer, and Groeben's (2002) Reading Experience Scale (RES-SD); response format: 7-point Likert scale ranging from strongly disagree *to* strongly agree*)*

I could completely empathize with the main character.

I could perfectly relate to the feelings and thoughts of the main character.

The main character remained a stranger to me. *(rev.)*

3.2.3 Suspense

('Suspense' subscale of Appel, Koch, Scherer, and Groeben's (2002) Reading Experience Scale (RES-S); response format: 7-point Likert scale ranging from strongly disagree *to* strongly agree*)*

I was eager to find out what was going happen next.

While I was reading I wanted to know how the events would unfold.

The story was gripping.

I was swept up in the story while reading.

The story was long-winded. *(rev.)*

3.2.4 Cognitive Involvement

("Cognitive Involvement" subscale of Appel, Koch, Scherer, and Groeben's (2002) Reading Experience Scale (RES-CI); response format: 7-point Likert scale ranging from strongly disagree *to* strongly agree*)*

I was reflecting a lot on the text.

I had the feeling while reading that the story also had significance for my life.

I compared the content of the story with my own knowledge.

While I was reading I thought about how best to deal with the situations described in the story.

I thought very little about the content of the story while reading. (rev.)

3.3 Text comprehension
(self-developed multiple-choice questions; response options were presented in randomized order)

What happens to all mortals who get to close to the sirens, following their enchanting songs?

a) The sirens devour their victims so that only skin and bones remain. ***[correct response]***
b) The sirens pull their victims under water so that they drown and sink to the ground.
c) The sirens keep their victims imprisoned on the island so that they have to serve them as slaves until they die.
d) The sirens lull their victims with their songs so that their ships crash against a suddenly emerging rock and sink.

Why does Ulysses decide to steer his ship through the strait past Scylla and not past Charybdis?

a) He does not want to risk losing all of his companions. ***[correct response]***
b) He does not trust Circe's advice.
c) He thinks if he is lucky he might not lose a single companion.
d) He wants to kill Scylla using his arc.

Why can Ulysses companions persuade him to stop at the sun god Helios' island against his better judgement?

a) He is outvoted and thinks that it will only be a brief stopover. ***[correct response]***
b) He is outvoted and is tired and exhausted himself.
c) He is outvoted and has learned that Circe's warnings do not always have to be taken seriously.
d) He is outvoted and is afraid of mutiny.

Why can Eurylochos convince the companions to slay the sun god's cattle against Ulysses' instructions?

a) They think the sun god will eventually forgive them for slaying a couple of cows. ***[correct response]***
b) They think that the sun god will not notice that a few cows are missing.
c) They think that they will leave the island soon and escape from the sun god's punishment.
d) They think that they are allowed to slay the cows if they are starving otherwise.

What ultimately saves Ulysses when he gets back to the strait between Scylla and Charybdis as the only shipwreck survivor?

a) The fig tree because he can hang on to it and wait until the Charybdis spits his raft back out. ***[correct response]***
b) The fig tree because when he hangs on it, Scylla's voracious heads cannot reach him.
c) The raft because sitting on it, he drifts through the strait in the exact moment that Scylla and Charybdis cannot get to him.
d) Zeus because he keeps both Scylla and Charybdis at bay until Ulysses has safely passed through the strait.

At the Heart of Optimal Reading Experiences:

Cardiovascular Activity During Flow in Fiction Reading

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Author Note

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Abstract

Fiction reading ranks as one of the most popular leisure activities, evoking various pleasurable experiences, such as suspense, interest, and—as indicated by recent empirical evidence—also flow. The experimental study reported in this paper focused on the psychophysiological underpinnings of flow during fiction reading. Cardiovascular data were collected from a sample of 84 participants during a relaxation baseline and during reading. Participants were randomly assigned to read one of three versions of a chapter from Homer's *Odyssey*. The text versions differed substantially in terms of their writing style, as reflected in divergent readability indices. Flow was measured immediately after reading with a self-report scale specifically tailored to the reading context. Regression analyses revealed that cardiovascular activation patterns associated with parasympathetic dominance supported flow if the text had medium to high stylistic demands, but not low demands. Thus, parasympathetically induced high cardiac vagal tone seems to facilitate flow under cognitively challenging reading conditions. These results indicate that the reader's physiological state interacts with the text's stylistic properties in creating flow and thereby optimal reading experiences. Overall, our results highlight the potential of integrating psychophysiological measures into reading research and of applying flow theory to mental activities such as reading.

Keywords: flow, fiction reading, cardiovascular activity, readability, vagal tone

Introduction

Despite the mental effort involved, reading fictional narratives can evoke a sense of relaxation and pleasure when the reader becomes immersed in a fictional world (Buselle & Bilandzic, 2009; Green, Brock, & Kaufman, 2004; Nell, 1988). This pleasant state of mind has been the subject of an increasing number of reading studies. To assess it empirically, readers have been instructed to think aloud (e.g., Miall & Kuiken, 1999) or to give retrospective self-reports through interviews (e.g., Ross, 1999) or questionnaire methods (e.g., Buselle & Bilandzic, 2009). However, interrupting the reading process or asking for subsequent subjective evaluations might inflate measurement errors. Therefore, psychophysiological indicators are a useful addition to such approaches to measurement, as they are independent of self-awareness, memory effects, and common self-report biases such as social desirability (Potter & Bolls, 2012). Moreover, psychophysiological measures seem particularly suited for reading research, as some of the methodological difficulties of psychophysiology do not apply in this context. Specifically, the influences of physical effort or interference between measurement acquisition and activity engagement play only a minor role in the context of mental activities like reading.

For employing psychophysiological methods in reading research, two requirements need to be met: First, a theoretical link between the physiological signal and the psychological state of the reader needs to be established. Second, variability in the signal caused by sources that are unrelated to the reading experience need to be controlled through a rigid experimental design (Cacioppo, Tassinary, & Berntson, 2007). However, given the plethora of partly overlapping theoretical concepts in reading research, a theoretical link to psychophysiology is not straightforward. Concepts such as *immersion* (Murray, 1997), *presence* (Gerrig, 1993), *transportation* (Green et al., 2004), *narrative engagement* (Buselle & Bilandzic, 2009), and *story world absorption* (Kuijpers, 2017) differ only in terms of

particular subdimensions, the type of narrative medium addressed, or the hypothetical level of involvement. At the same time, they share a critical degree of conceptual vagueness (Buselle & Bilandzic, 2009). Lack of clarity in the theoretical understanding of the reading experience renders its experimental manipulation and assessment problematic, especially in terms of psychophysiological measures. For instance, in one of the few psychophysiological studies on reading experiences published to date, Sukalla, Bilandzic, Bolls, and Busselle (2015) tested the validity of a self-report scale for narrative engagement in terms of psychophysiological correlates. However, for two of the four theoretical subdimensions of the scale, the theoretical associations with psychophysiological measures were unclear. To complicate matters further, experimental manipulation, which is essential for a valid interpretation of psychophysiological data, is in itself a highly controversial approach when it comes to carefully crafted literary artworks (Willems & Jacobs, 2016).

Against this background, we want to make a case for adopting the concept of *flow* (Csikszentmihalyi, 1975) as a theoretical framework for psychophysiological reading research. Designating an intrinsically enjoyable state of complete engagement, flow has traditionally been linked to physical and competitive activities such as sports or gaming. In expanding flow research to include mental activities as well, flow has been applied to fiction reading both in theory (e.g., Buselle & Bilandzic, 2008, 2009; Green et al., 2004) and in empirical studies (Massimini, Csikszentmihalyi, & Delle Fave, 1988; McQuilian & Conde, 1996; Thissen, Menninghaus, & Schlotz, 2018). However, the potential of psychophysiologically studying flow during reading has not yet been explored. Compared to other reading-related concepts, flow is relatively well-defined in terms of the state's specific characteristics and the circumstances under which it arises, so that strategies for both experimental manipulation and potential psychophysiological correlates can be derived from this definition.

According to flow theory, experiencing an optimal stimulation level in an activity will lead to a specific state of mind that is defined by simultaneously experiencing the so-called *flow components*: (1) a merging of action and awareness, (2) a heightened focus of attention, (3) a loss of self-awareness, (4) an altered sense of time, (5) a feeling of competence, (6) a perception of coherent demands, (7) clarity of goals, (8) an unambiguous understanding of activity feedback, and (9) intrinsic enjoyment (Csikszentmihalyi, 1975; Jackson & Marsh, 1996; see Thissen, Menninghaus, & Schlotz, 2019, for a reading-specific adaptation of the flow components). Taken together, these components of flow account for a high degree of absorption, fluent processing, and enjoyment in engagement with an otherwise challenging task (Rheinberg, Vollmeyer, & Engeser, 2003).

Following the *flow channel model* (Csikszentmihalyi, 1975), which is well supported by empirical evidence (see Fong, Zaleski, & Leach, 2015, for an overview), flow states result from a perceived balance between an individual's skills and the challenge level of an activity. In experimental research, flow states are therefore typically induced by manipulating the demands of an activity (Moller, Meier, & Wall, 2010). The most common experimental paradigm involves a flow condition, in which the demands match the participants' skills, as well as two control conditions. In one of the control conditions (the overload condition), the demands exceed the participants' skills, while in the other (the boredom condition), the participants' skills exceed the demands. To date, three strategies have been employed to experimentally induce flow: the creation of intermediate demands (e.g., Rheinberg et al., 2003), a continuous adaptation of demands to participants' performance (e.g., Keller & Blomann, 2008), and pre-assessing participants' skills and then assigning them to matching demand levels (e.g., Moller, Csikszentmihalyi, Nakamura, & Deci, 2007).

Demand manipulation is not trivial in the context of fiction reading, as the demand level of a text depends on a complex interplay of content, stylistic features, and composition.

A promising approach could be to manipulate stylistic features that have a bearing on cognitive challenge while keeping the narrative content and composition constant. The linguistic concept of *readability* offers a way to quantify a text's vocabulary and syntactic complexity for this purpose. Readability is defined as "the ease of understanding or comprehension due to the style of writing" (Klare, 1963, p. 3) and can be approximated by computing indices based on text features such as the number of words per sentence or the number of syllables per word.

Provided that a reader is motivated to engage with the narrative at hand, stylistic text demands, i.e., the text's level of readability, might influence the reader's probability of entering a flow state. Importantly, however, flow does not depend on challenge alone, but rather on a perceived balance of skills and challenges. Because both skill levels and subjective evaluations of a text's demands can vary across readers, and content-related demand factors also matter, selective manipulation of stylistic text demands alone might not suffice to substantially affect readers' flow experiences. Yet the possibilities for operationalizing the overall challenge level of a text and for measuring adults' reading skills are fairly limited, so matching or dynamically adapting a text to the reader to experimentally induce flow does not seem feasible. To obtain a viable first approach to experimental flow research in fiction reading, we opted to instead pre-evaluate reading motivation and the individual flow potential of a given text, and to specifically manipulate stylistic texts demands. This approach differs from the commonly used experimental paradigms in general flow research in that the different demand levels involved do not represent control conditions. Rather, they represent different levels of challenge, corresponding to different probabilities of generating flow states during reading. Given that cognitive challenge alone may affect psychophysiological responses, an experimental design involving different levels of

challenge can also help to identify effects that are truly characteristic of flow states as indicated by stability across conditions.

Recent flow research has shown an increased interest in psychophysiological assessment (see Knierim, Rissler, Dorner, Maedche, & Weinhardt, 2018, for an overview). However, flow during engagement with mental activities has to date rarely been studied from a psychophysiological perspective, and not at all in the context of reading. The results of psychophysiological flow studies involving physically more demanding activities suggest that, for all its proverbial fluency and ease, flow is also associated with effort (Keller, Bless, Blomann, & Kleinböhl, 2011). At the same time, however, the effort involved in flow does not seem to compromise positive affect (De Manzano, Theorell, Harmat, & Ullén, 2010), and appears to be modulated by relaxing influences (Ullén, De Manzano, Theorell, & Harmat, 2010), so that an overall intermediate level of arousal arises (Peifer, 2012).

Whereas optimal engagement apparently involves arousal and effort in the activities that previous psychophysiological flow research has focused on, the activity of fiction reading is primarily associated with overall physical and subjective relaxation (Clark & Rumboldt, 2006; Nell, 1988). Furthermore, the specific activity during which flow arises in the context of fiction reading is presumably not the highly automatized decoding of letters itself, but the construction of a mental story model (Buselle & Bilandzic, 2008). Such higher-level cognitive processing has been linked to activation in the parasympathetic nervous system (PSNS; Thayer, Hansen, Saus-Rose, & Johnsen, 2009; Thayer & Lane, 2009), the branch of the autonomic nervous system (ANS) that is active during resting states and inner relaxation (Cacioppo et al., 2007). The sympathetic nervous system (SNS), on the other hand, is the reciprocal branch that is active during quick mobilizations of energy and heightened arousal. Whereas the SNS responds to high levels of cognitive challenge and stress (Callister, Suwarno, & Seals, 1992), the fluent cognitive processing of a balanced cognitive challenge is

likely to be facilitated under PSNS dominance. This assumption is based on findings suggesting that PSNS activation reflects the allocation of mental resources to cognitive processing (Potter & Bolls, 2012), which has also been shown for the cognitive processing of media stimuli (Wise, Bolls, Myers, & Sternadori, 2009). In particular, PSNS activity is related to more efficient energy exchange (Grossman & Taylor, 2007) and better information encoding (Park & Thayer, 2014). Moreover, sustained attention (Luque-Casado, Perales, Cárdenas, Sanabria, 2016) , heightened focus (Wu & Lo, 2008), and emotion regulation (Park & Thayer, 2014), as well as social cognition (Porges, 2011)—all of which most likely play a role in the construction of mental story models—are linked to PSNS dominance. Considering the nature of flow as a state characterized by heightened absorption and processing fluency in carrying out the activity at hand, PSNS activation could therefore be a psychophysiological correlate of flow during reading.

Cardiovascular activity is a particularly revealing indicator of PSNS influences and of the interaction between mind and body in cognitive processing (Potter & Bolls, 2012). As illustrated in the *neurovisceral integration model* (Thayer et al., 2009; Thayer & Lane, 2009), the cardiovascular system and the heart as a part of it are linked to prefrontal brain areas that are involved in cognitive performance through different sympathetic and parasympathetic pathways. Among these, the vagus nerve represents the most important parasympathetic connection. Vagal input causes the sinus node—the heart's primary pace maker—to decelerate the heart rate (HR), reducing the number of heart beats per minute (bpm). Through an electrocardiogram (ECG), the HR can be measured in terms of the so-called R spikes in the signal. Moreover, the ECG signal indicates the variability of the time between heart beats in terms of intervals between R-spikes (RR intervals), which is known as heart rate variability (HRV). Whereas the HR, as a product of both SNS and PSNS influences, is largely reflective of a person's inner state and response to stimulation, HRV provides more detailed

information about PSNS activation. In particular, the root mean square of successive differences (RMSSD) between normal heart beats, derived by analyzing HRV in the time domain through a comparison of the duration of adjacent RR intervals, serves as an indicator of PSNS activity (Malik, 1996). Given that the RMSSD is relatively unaffected by respiration (Laborde, Mosley, & Thayer, 2017) and does not depend on the length of the recording period (Malik, 1996), it is widely accepted as the primary time-domain measure for vagal tone(Shaffer & Ginsberg, 2017).

To date, flow research involving cardiovascular measures has produced mixed results. Whereas some evidence points to the dominance of the SNS (Bian et al., 2016; De Manzano et al., 2010; Gaggioli, Cipresso, Serino, & Riva, 2013; Keller et al., 2011), other studies have identified PSNS activation in the form of a decreased HR (Drachen, Nacke, Yannakakis, & Pedersen, 2010) and increased HRV during flow (Léger, Davis, Cronan, & Perret, 2014; Peifer, Schächinger, Engeser, & Antoni, 2015; Tozman, Magdas, MacDougall, & Vollmeyer, 2015). Given that these studies involved different activities, the partially contradictory findings may suggest that the activity context needs to be considered when it comes to the relationship between cardiac activity and flow experiences.

For the specific context of fiction reading, hypotheses about the cardiovascular correlates of flow can be formulated based on the theoretical associations between PSNS dominance and fluent cognitive processing. In particular, cardiac vagal tone, which reflects PSNS dominance, represents a potential psychophysiological underpinning of flow states during the fluent construction of mental story models. Therefore, we expected to find negative associations between the HR and flow (hypothesis 1) and positive associations between the RMSSD and flow (hypothesis 2). The more difficult a text is, the more pronounced these effects should be. Therefore, we further expected significant interactions between the experimental condition and the HR (hypothesis 3) and also the RMSSD

(hypothesis 4). Accordingly, the stylistic demand level, which we operationalize in terms of readability and interpret as an indicator of cognitive challenge, would serve as a moderator for the association between flow and cardiovascular activity. We assume that PSNS-dominated cardiovascular activation patterns can facilitate individual flow experiences under demand conditions that would otherwise hinder the emergence of flow. Specifically, PSNS activation might help individuals to subjectively evaluate relatively high demand levels as an optimal challenge rather than an excessive one, thereby supporting flow.

Assuming that PSNS activation might also be an indicator of flow states themselves, we further expected flow experiences to affect cardiovascular activity. Compared to a relaxation baseline, we expected the HR to decelerate (hypothesis 5) and the RMSSD to increase (hypothesis 6) across the reading phase when a reader experiences flow. Such a finding would support the notion that cardiovascular activity can serve as an objective measure of flow states during reading. The reading experiment presented in the following section was conducted to empirically test these hypotheses.

Methods

Participants

A total of 94 readers participated in the experiment. All participants were pre-selected based on their above-average self-reported flow after reading a chapter of Homer's *Odyssey* in a previous online study (Thissen et al., 2019). Given that the present experiment involved reading another chapter from the *Odyssey*, we expected this reader sample to have high reading motivation and to easily experience flow again when reading the new chapter. These assumptions were based on the known stability of both reading motivation (Clark & Rumbold, 2006) and reader skills in adults (Schneider, Schlagmüller, & Ennemoser, 2017). Notably, the new chapter read in the present experiment was similar in many ways to the chapter read in the pre-study, for instance, in terms of the characters and narrative structure.

Therefore, we surmised that, in our experiment, an optimal balance of skills and challenge could be experienced once again by these particular readers.

The final sample size was eventually reduced to $N = 84$, as questionnaire data from one participant were lost due to a technical problem and cardiovascular data from seven participants could not be edited due to trigger malfunctions. Additionally, two participants had cardiac pacemakers and were therefore excluded from the analysis. The final sample covered an age range from 19 to 73 years ($M = 35$; $SD = 16$), with the majority being female (57%; $n = 48$) and a considerable percentage holding graduate degrees (49%, $n = 41$). Participants were randomly assigned to one of three experimental conditions in which different versions of the text were read. This randomization was successful in that the subsamples ($n = 29$; $n = 31$; $n = 24$) did not differ significantly across relevant characteristics such as demographics, reader variables, reader traits, and reader skills (see Supplemental Material, Table S1).

Design and Procedure

The study was conducted in a research lab that was designed to resemble a living room. Each participant completed the experiment individually under the surveillance of a research assistant. Upon arrival in the lab, the participant received a written description of the study, gave his or her informed consent, and was acquainted with the equipment. Seated in a reading armchair, the participant filled out a questionnaire regarding reader traits and skills that was presented via LimeSurvey software (Schmitz, 2012) on a tablet computer. Subsequently, the participant was prepared for cardiovascular measurement. After the research assistant visually inspected the ECG signal, the participant was instructed to sit still and relax for 10 minutes. Then the participant was given a bookrest on which a book containing the Odyssey chapter was fixated. Each participant was randomly assigned to read one of three versions of Book 9 of Homer's *Odyssey*, which were characterized by either high

readability, intermediate readability, or low readability. To prevent distractions, the research assistant left the room until the participant rang a bell and pushed a trigger to indicate that he or she had finished reading. After reading, the participant filled out a questionnaire about the reading experience and once again sat still for a 10-min recovery phase. The participant was eventually debriefed and rewarded with € 30. For a graphical depiction of the procedure, please see Supplemental Material, Figure S1.

Reading Material

Each participant read one of three versions of a chapter of Homer's *Odyssey*, the ancient Greek story of Ulysses's eponymous wandering and adventures on his way home from the Trojan War. In this self-contained episode, called Book 9, Ulysses and his companions get trapped in the lair of a cyclops, a one-eyed, man-eating giant, and they must rely on Ulysses's wits to save their lives. This storyline was the same for all text versions, so that the text demand due to content was kept constant. At the same time, the text demand due to the writing style varied across the conditions, which we expected would also be reflected in terms of readability. To obtain different readability levels, we employed an old prose translation from 1958 by Wolfgang Schadewaldt, a modern prose translation from 2010 by Karl Ferdinand Lempp, and a simplified version of the modern prose translation that was created with the help of literary scholars.

To determine the reading difficulty of our texts, we tokenized the texts with the NLTK sentence tokenizer (Bird & Loper, 2004) and measured readability indices for the different translations with the Python *readability* package by van Cranenburgh (https://github.com/andreasvc/readability), which allows the calculation of several standard measures for German based on surface characteristics. Most of these indices utilize sentence length (in words), in terms of which our text versions strongly differ. The text versions also differ in their counts of long and complex words; for instance, the old prose version is

characterized by the use of outdated and difficult vocabulary, which is likely to impede readability. Overall, the readability indices (such as Flesch-Kincaid-Grade-Level and Gunning-Fog-Index) thus confirmed our expectations regarding high readability for the simplified version, intermediate readability for the modern prose version, and low readability for the old prose version of the Odyssey chapter (see Supplemental Material, Table S2).

Self-Report Measures

Demographic data as well as reader variables including frequency of reading fictional narratives, general affinity for fiction reading, and interest in reading the *Odyssey* were assessed using single items. Furthermore, reader traits that might influence the reading experience were assessed, such as reading self-efficacy, as measured by four self-developed items (Thissen et al., 2019), aesthetic responsiveness, as measured by the 14-item Aesthetic Responsiveness and Engagement Assessment (AREA; Schlotz, Wallot, Omigie, Masucci, & Vessel, 2019), and proneness to boredom, as measured by the 8-item Short Boredom Proneness Scale (SBPS; Struk, Carriere, Cheyne, & Danckert, 2017). To measure reader skills, we presented an online adaptation of Schneider, Schlagmüller, and Ennemoser's (2017) Reading Speed and Comprehension Test (Lesegeschwindigkeits- und Verständnistest; LGVT). This speed test comprises a cloze test with three response options per deletion from which to choose based on the textual context. The LGVT provides information about reading speed, comprehension, and accuracy in adolescent reader samples, yet it appears to be applicable to more advanced readers as well (Thissen et al., 2019) . With regard to their reading experience in this experiment, specifically in terms of flow, participants answered the 27-item Fiction Reading Flow Scale (FRFS; Thissen et al., 2019). Moreover, as a manipulation check, single items were used to assess whether participants found the *Odyssey* chapter to be excessively or not very demanding to read.

Single items were rated either on a 7-point Likert scale ranging from *not at all* to *very much* or with a binary response format. For the SBPS and FRFS, a 7-point Likert scale ranging from *strongly disagree* to *strongly agree* was employed. A 5-point Likert scale was used for both the reading self-efficacy items and the AREA, ranging from *not at all* to *very much* for the former and from *never* to *very often* for the latter. All scale scores were calculated by averaging responses. For further information about the item wordings and the scales employed, please see the Supplemental Material.

Cardiovascular Measures

ECG measurement was conducted according to established guidelines (Gramann & Schandry, 2009; Potter & Bolls, 2012) using a BioPlux amplifier (Plux, Portugal), which was connected via Bluetooth to a laptop computer running OpenSignals (r)evolution version 2018-03-27 (Plux, Portugal). To record the ECG, we used three pre-gelled 8-mm AG/AGCL ECG electrodes (H135SG, Covidien, Ireland) that were connected to the BioPlux amplifier's electrocardiography sensor (gain: 1.000; bandwidth: 0.5–100 Hz). The positive electrode was placed on the sternum, the negative electrode between the fourth and fifth rib on the left pectoralis major, and the grounding electrode above the rib at the end of the left rib cage. All data were sampled at a rate of 1,000 Hz and with a 16-bit resolution, and relaxation and reading phases were digitally marked using the BioPlux handheld switch trigger.

The ECG signal was postprocessed offline using Matlab's Fieldtrip (Oostenveld, Fries, Maris, & Schoffelen, 2011) and Biosig (Vidaurre, Sander, & Schlögl, 2011) toolboxes. First, data were extracted from the analog ECG waveforms with the appropriate transfer functions (Plux, Portugal) and edited using the trigger markers. To identify the RR intervals, we employed Biosig's nqrs-detect function, which decomposes the signal into subbands, downsamples it, and applies multiple beat-detection algorithms (Afonso, Tompkins, Nguyen, & Luo, 1999). As a correction for artefacts, which may arise due to movement, electrical

interference, or poor lead placement (Laborde et al., 2017), we applied square and quotient filters that filtered out spikes in the signal which show RR intervals shorter than 300 ms or longer than 2,000 ms (square filter) and RR intervals that show more than a 20% change (quotient filter). This procedure separates incorrectly detected beats from heart beats with a sinus node origin (Piskorski & Guzik, 2005). The data quality was subsequently confirmed by visually inspecting tachograms and Poincaré plots. To obtain the HR values, we transferred the filtered RR intervals to the time domain. To further obtain the HRV values, we reverted to Biosig's heartratevariability function, which calculates the RMSSD (Shaffer & Ginsberg, 2017). Both the HR and the RMSSD were aggregated across the duration of the pre-reading relaxation baseline and across the duration of the reading phase for each participant.

Statistical Analysis

As a manipulation check, we examined group differences in terms of perceived demands across the conditions using Kruskal Wallis tests and Bonferroni-adjusted Dunn's post-hoc tests, given that Lilliefors tests had revealed nonnormality. We further explored whether flow experiences differed across conditions by conducting a one-way analysis of variance (ANOVA) and Bonferroni-adjusted pairwise T-tests as post hoc tests, since the flow scores were normally distributed and showed equal variability in the different conditions.

To test hypotheses 1 and 2, we employed linear regression models, regressing flow scores on the HR and the RMSSD, respectively, during reading. To further test the moderating effect of demand in terms of readability (see hypotheses 3 and 4), we entered the experimental condition and its interaction with the cardiovascular indicator into each model. To test hypotheses 5 and 6, we regressed the flow scores on the change scores between the baseline and the reading HR and RMSSD, respectively.

We conducted sensitivity analyses to check the robustness of the results. First, we repeated the regression models after excluding potentially influential outliers, defined as data points more than 3 standard deviations from the mean. Second, we adjusted the regression models for reading accuracy, as participants in the different conditions had shown a marginally significant difference on this variable. Before conducting all regression analyses, we confirmed the basic assumptions of regression modeling by visually inspecting diagnostic plots for the linearity of associations, the normality of residuals, and potentially influential outliers, and we tested the homogeneity of the error variance by means of Levene tests. All statistical analyses were performed using R version 3.6.1 (R Core Team, 2016).

Results

Manipulation Check

Significant group differences for both low demand ($\chi^2(2) = 10.65, p < .01$) and excessive demand perceptions ($\chi^2(2) = 13.26, p < .01$) confirmed the efficacy of our experimental manipulation. On the one hand, participants in the high readability condition reported lower demand ($Mdn = 5$) than those in the intermediate readability condition ($Mdn = 2, p < .05$) and the low readability condition ($Mdn = 2, p < .05$). On the other hand, participants in the low readability condition reported higher demand ($Mdn = 2$) than those in the high readability condition ($Mdn = 1, p < .001$) and the intermediate readability condition ($Mdn = 1, p < .001$). Thus, as intended, the demand level of the simplified text was perceived as relatively low and the demand level of the old prose translation was perceived as relatively high, with the modern translation scoring between these extremes.

Regarding flow, we found a significant effect of the condition ($F[2, 81] = 3.17, p = .047$). Post hoc tests, however, did not confirm significant group differences. Flow scores tended to be slightly lower only in the low readability condition, as compared to the high readability and medium readability conditions (see Table 1). As can further be seen in Table

1, flow scores exceeded the midpoint of the response scale across all conditions. This observation indicates that, overall, the reading experience in the experiment generated flow.

Cardiovascular Activity and Flow During Reading

Confirming hypothesis 1, the HR was negatively associated with flow scores ($\beta = -.35, t[82] = -3.33, p < .01$) and explained a significant amount of variance in flow scores across conditions ($R^2 = .12, F[1, 82] = 11.11, p < .01$). Hypothesis 2 was also confirmed. as the data showed positive associations between the RMSSD and flow scores ($\beta = .23, t[82] = 2.12, p < .01$). HRV thus also explained a significant amount of variance in readers' flow experiences across conditions ($R^2 = .05, F[1, 82] = 4.48, p < .05$).

As can be seen in Table 2, the experimental condition—i.e., the text's readability level—served as a moderator for the effect of the HR on flow. This confirmed hypothesis 3, as the regression slope for the high readability condition was significantly different from the regression slopes for the other conditions. Accordingly, the interaction between the HR and the experimental condition ($F[2, 78] = 5.12, p = .011$) as well as the main effects of the HR ($F[1, 78] = 4.71, p = .004$) and of the experimental condition ($F[2, 78] = 4.02, p = .027$) were significant. For both the intermediate readability condition ($F[1, 78] = 4.69, p = .034$) and the low readability condition ($F[1, 78] = 13.15, p = .001$), the regression slopes differed significantly from zero (see Figure 1).

Table 3 shows similar results for the test of hypothesis 4: The slope for the regression of flow on the RMSSD in the high readability condition differed significantly from the regression slope in the low readability condition. The interaction between the RMSSD and the experimental condition ($F[2, 78] = 5.62, p = .005$) as well as the main effect of the experimental condition ($F[2, 78] = 3.63, p = .031$) were both significant, whereas the main effect of the RMSSD ($F[1, 78] = 3.19, p = .078$) was only marginally significant. Post hoc tests showed that the regression slope was significantly different from zero ($F[1, 78] = 12.58,$

p = .001) in the low readability condition (see Figure 2), but not in the other conditions (high readability condition: $F[1, 78] = 0.43$, p = .515; intermediate readability condition: $F[1, 78] = 1.41$, p = .238).

Neither the regression model that was replicated with the HR change score in order to control for the baseline HR (see Table 2) nor the corresponding overall tests of interaction and main effects showed significant effects. Therefore, hypothesis 5 was not supported by our data. Similarly, the regression results (see Table 3) and the corresponding overall tests of interaction and main effects did not substantiate associations between RMSSD changes and flow. Thus, hypothesis 6 was not confirmed either.

For all regression models, excluding outliers from the analyses did not substantially alter the results. The same was true for adjusting the regression models, which involved the experimental condition as a predictor, for reading accuracy. Hence, reading accuracy did not confound any of the effects of the reading demand on flow experience that are reported above (see Supplemental Material, Tables S3 to S6, for details).

Discussion

Considering the so far largely untapped potential of integrating psychophysiological measures into reading research, we conducted an experiment to investigate the interplay of cardiovascular activity and flow during fiction reading. Whereas cardiovascular activity is a physiological measure linked to cognitive text processing, flow is a psychological state linked to reading pleasure. Our reading experiment, involving high, intermediate, and low readability versions of the same text, revealed significant associations between cardiovascular measures and subjective flow experiences. Specifically, a low HR and high RMSSD, both indicating high vagal tone and therefore parasympathetic dominance, seemed to support flow during reading. However, this effect was modulated by the text's level of readability: It was

not observed in the case of the high readability text. Moreover, no evidence that changes in cardiovascular measures are associated with flow was found.

Our manipulation of stylistic text demands and readability was successful, as participants in the high readability condition perceived the text as rather simple to read, whereas participants in the low readability condition perceived the text as rather difficult. However, participants reportedly experienced flow across all experimental conditions and hence across all levels of stylistic text demand and readability. It should be noted, though, that in addition to stylistic text demands, various other factors contribute to the subjective evaluation of optimally balanced skills and challenges that underlie flow in the context of reading. Additional main factors that should be considered include content-related text demands and rewards, differences in reader skills, reading motivation, and individual responses to challenges. Taken together, all of these factors apparently outweighed the effect of suboptimal stylistic text demands on flow experiences during reading. General flow research has also shown that individual and situational factors, such as self-efficacy and the personal significance of an activity, can modulate an individual's evaluation of skills and challenges and thereby flow (Engeser & Rheinberg, 2008; Rheinberg et al., 2003). Thus, the influence of stylistic text demands and thereby readability on the likelihood of flow is certainly limited.

General flow research frequently reverts to computer gaming stimuli (Engeser & Rheinberg, 2008; Keller & Blomann, 2008; Moller et al., 2007) in order to be able to thoroughly manipulate the balance between skills and challenges. In the context of gaming stimuli, demands depend on single, easily measurable variables (e.g., the gaming speed), and skill levels can be premeasured and matched accordingly (e.g., through game score records). Flow research in fiction reading faces both more complex stimuli and more methodological difficulties. Still, the on-average high flow scores obtained in our study show that flow can be

elicited in readers under controlled laboratory conditions. Moreover, readability had a moderating effect on the associations between our participants' cardiovascular activity and their flow experiences. Therefore, readability manipulation was overall confirmed as a viable approach to experimental flow research in reading insofar as readability is one factor—although not the only one—that should be considered when predicting flow in this context. Given that readability is fairly easy to assess and manipulate, its use may help in overcoming some of the methodological difficulties of this research. At the same time, however, our results also substantiate the assumption that various factors play a role in the reading experience. Therefore, stylistic manipulations would probably have to be fairly strong to yield clear text-version-dependent differences in flow.

Regarding reader-related factors, our study shows that cardiovascular activity is linked to the experience of flow during reading. Cardiovascular activity reflects the reader's inner state and hence can be understood as an indicator for an individual's ability to apply his or her reading skills in a given reading situation. In particular, this holds regarding the positive relationship between cardiac vagal tone, i.e., PSNS activation, and cognitive performance (Thayer et al., 2009; Thayer & Lane, 2009). Taken together, the associations we found between a lower HR, a higher RMSSD, and higher flow scores in the experiment suggest that a relaxed inner state, characterized by PSNS dominance that results in high vagal tone, corresponds to flow when reading a stylistically challenging text.

It is notable that cardiovascular activity was not associated with flow in the high readability condition, in which a simplified and thus stylistically barely challenging text version was read. On the one hand, this result highlights the interaction of text and reader variables in generating flow states in fiction reading. On the other hand, it may help to nuance our understanding of the positive effect of vagal tone on fluent text processing. Considering that participants in the high readability condition tended to report flow even

though the stylistic text demands were suboptimal, it can be assumed that their flow experience was mainly driven by the story content. Readers who optimally engaged with the story content and therefore experienced flow in this condition did not differ in terms of cardiovascular activity from those who did not. This suggests that text processing with a focus on story content and not on stylistic text demands may be largely independent of the underlying cardiovascular pattern and, more specifically, the vagal tone. However, when readers also had to process a certain level of stylistic text difficulty, as was the case in the other two conditions, a cardiovascular activation pattern associated with high vagal tone was shown to facilitate flow experiences. Therefore, text processing of more demanding writing styles appears to be a part of the construction of mental story models that can be performed more fluently under the influence of high vagal tone.

In line with this notion, comparisons between different types of cognitive tasks have revealed that vagal tone is linked in particular to perceptual abilities and sustained attention (Luque-Casado et al., 2016; Luque-Casado, Zabala£, Morales, Mateo-March, & Sanabria, 2013). These cognitive abilities also seem relevant for basic text comprehension. In the high readability condition, the easily understood way in which the text was written supported basic text comprehension. In the intermediate and low readability conditions, the more challenging way in which the text was written did not necessarily do so; in these conditions, the inner state of the reader, specifically a high vagal tone, supported basic text comprehension by enabling the reader to master stylistic text demands. Either way, once the reader achieved a basic comprehension of the text, higher-level text processing could follow suit and eventually result in a flow experience.

A cardiovascular pattern associated with inner relaxation—i.e., a low HR and high RMSSD—when a reader was presented with a somewhat difficult text could imply that the reader subjectively perceived the text as still not being too difficult to read. In this way,

cardiovascular activation might provide information about the perception of challenge. Specifically, the cardiac vagal tone might be indicative of the subjective experience of optimal stimulation that underlies flow states. However, it does not seem to serve as a direct indicator for the flow state itself, for in the case of both the HR and the RMSSD, the associations with readers' flow experiences did not persist when controlling for the baseline. This implies that the observed effects were not driven by differences in participants' cardiovascular activity during reading, but rather by differences across both the baseline and the reading phase. If flow experiences during reading altered cardiac output, the observed effects would be driven by differences in cardiovascular activation between readers who experienced flow and readers who did not experience flow in the reading phase. In this case, the effects would remain significant even when the baseline activity is controlled for. However, the effects appear to in fact be driven by differences in cardiovascular activation between participants that already existed in the baseline phase and that did not change during the reading phase. Consequently, these differences could not have been caused by experiencing flow. If there were a characteristic cardiac signature of flow during reading that could serve as an objective measure, it should clearly differ from the baseline measures and be similar across all types of reading situations involving flow. However, the cardiovascular activation pattern that we found to be associated with flow was virtually the same in the baseline and reading phases and only supported flow experiences in reading situations that involved stylistically challenging texts. Therefore, our results do not necessarily support the use of cardiovascular indicators as objective measures for flow during reading.

At the same time, this does not imply that cardiovascular activation does not play a role, maybe even a crucial one, for flow experiences during reading. Notably, the resting state vagal tone is known to be a relatively stable individual characteristic (Thayer & Lane, 2009) that can influence cognitive performance on a general level (Park & Thayer, 2014). In this

sense, the cardiac vagal tone during rest could be one of the individual reader factors that are relevant for proneness to flow experiences during reading. However, we cannot say how much the baseline data we obtained in this study represent a trait-like disposition rather than a state assessment. Thus, at this point we can only speculate and encourage the inclusion of readers' cardiovascular dispositions as a potentially insightful reader variable in future studies.

Future research is also needed to learn more about the distinct nature of flow in mental activities such as fiction reading as compared to physical ones. Notably, our results regarding relaxation and PSNS activation do not match those reported in some flow studies in more physical domains (Bian et al., 2016; De Manzano et al., 2010; Gaggioli et al., 2013; Keller et al., 2011). Combining the psychophysiological findings of studies on physical activities and on mental activities might significantly further our understanding of flow, by clarifying which features are universally characteristic of this state. Rather than looking at single activity contexts and certain psychophysiological measures as indicators for flow, various psychophysiological measures across many activity contexts should be integrated to obtain an adequate representation of this state.

Concerning the specific context of fiction reading, our study shows that flow states can be investigated both experimentally and in regard to their psychophysiological underpinnings. Thus, the flow concept indeed affords a way for reading research to implement psychophysiological experiments. Future reading research might also explore other approaches to developing study designs based on flow theory. For instance, Shahian, Pishghadam, and Khajavy (2017) successfully implemented a quasi-experimental design based on the effect of familiarity with the topic on a text's potential for individual flow.

Further studies on flow during fiction reading are also called for to test the generalizability of our results. Considering our focus on a single narrative, the

unrepresentative reader sample, and the aggregation of cardiovascular indicators over a relatively long period of time, the evidence from our study is certainly limited. Future research should aim for a more comprehensive understanding of the role of ANS activation with respect to flow during fiction reading. To this end, a fine-grained analysis of the temporal dynamics within the reading process would seem to be promising. Moreover, integration of psychophysiological indicators other than cardiovascular measures should be considered, especially those that are informative regarding SNS activation, such as electrodermal activity (Potter & Bolls, 2012). Thus, while our study provides the first evidence for the potential of psychophysiological flow research in fiction reading, it is only the first step into a largely uncharted terrain.

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Table 1

Summary of Correlations, Group Means, and Standard Deviations for Cardiovascular Measures During the Baseline and Reading Phases (Aggregated Within Phase) and for Self-Reported Flow Experience During Reading in the Three Experimental Conditions (High, Intermediate, and Low Readability)

	M	*SD*	1	2	3	4	5
High readability							
Baseline							
1. HR	71.93	10.14	–	-.50**	.92***	-.37*	.16
2. HRV-RMSSD	45.92	25.71		–	-.45*	.91***	-.14
Reading							
3. HR	71.37	9.35			–	-.39*	.16
4. HRV-RMSSD	45.31	23.43				–	
5. Flow	5.54	0.73					–
Intermediate readability							
Baseline							
1. HR	71.56	10.92	–	-.59***	.96***	-.63***	-.42*
2. HRV-RMSSD	41.87	26.73		–	-.54**	.95***	.20
Reading							
3. HR	70.83	10.70			–	-.59***	-.42*
4. HRV-RMSSD	40.23	24.56				–	.23
5. Flow	5.54	0.68					–
Low readability							
Baseline							
1. HR	74.71	10.94	–	-.49*	.96***	-.68***	-.55**
2. HRV-RMSSD	38.94	17.77		–	-.40*	.66***	.45*
Reading							
3. HR	76.33	10.96			–	-.70***	-.56**
4. HRV-RMSSD	32.92	16.23				–	.56**
5. Flow	5.05	0.99					–

Note. HR = heart rate; HRV= heart rate variability; RMSSD = root mean square of successive differences in the HRV.

* $p < .05$, ** $p < .01$, *** $p < .001$.

Table 2

Summary of Regression Analyses for the Mean Heart Rate (in bpm) Predicting Readers' Self-Reported Flow Experiences by Experimental Condition (High, Intermediate, and Low Readability); Reference Group Is High Readability

	Model 1				Model 2			
	B	*SE*	β	*p*	*B*	*SE*	β	*p*
Intercept	5.550	0.14	.00	**< .001**	5.532	0.15	.00	**< .001**
Intermediate readability	-0.056	0.19	-.03	.770	0.009	0.21	.01	.968
Low readability	-0.308	0.21	-.17	.144	-0.465	0.24	-.26	.058
Reading HR	0.012	0.02	.16	.414				
Intermediate readability × reading HR	-0.039	0.02	-.31	**.046**				
Low readability × reading HR	-0.062	0.02	-.46	**.003**				
HR change					-0.005	0.04	-.02	.888
Intermediate readability × HR change					0.005	0.06	.01	.940
Low readability × HR change					-0.003	0.07	-.01	.965
R^2	.25				.07			

Note. HR = heart rate. The HR was centered at the grand mean of each phase (72.6 bpm for reading values and 0.002 bpm for change scores). Model 1 uses the HR during reading as the cardiovascular predictor, while Model 2 uses the HR change score—i.e., participants' average baseline HR subtracted from their average HR during reading—as the cardiovascular predictor.

Table 3

Summary of Regression Analyses for the Root Mean Square of Successive Differences in the HRV (in ms) Predicting Readers' Self-Reported Flow Experiences by Experimental Condition (High, Intermediate, and Low Readability); Reference Group Is High Readability

	Model 1				Model 2			
	B	*SE*	β	*p*	*B*	*SE*	β	*p*
Intercept	5.556	0.14	.00	< **.001**	5.538	0.15	.00	< **.001**
Intermediate readability	-0.017	0.20	-.01	.929	0.011	0.21	.01	.961
Low readability	-0.266	0.22	-.15	.227	-0.451	0.23	-.25	.058
Reading RMSSD	-0.004	0.01	-.11	.515				
Intermediate readability × reading RMSSD	0.011	0.01	.19	.202				
Low readability × reading RMSSD	0.038	0.01	.42	**.001**				
RMSSD change					0.005	0.02	.06	.751
Intermediate readability × RMSSD change					-0.000	0.02	-.00	.993
Low readability × RMSSD change					0.001	0.02	.01	.966
R^2	.22				.08			

Note. RMSSD = root mean square of successive differences. The RMSSD was centered at the grand mean (39.9 ms for reading values and -2.5 ms for change scores). Model 1 uses the RMSSD during reading as the cardiovascular predictor, while Model 2 uses the RMSSD change score—i.e., participants' baseline RMSSD subtracted from their RMSSD during reading—as the cardiovascular predictor.

Figure 1. Flow and Mean Heart Rate During Reading

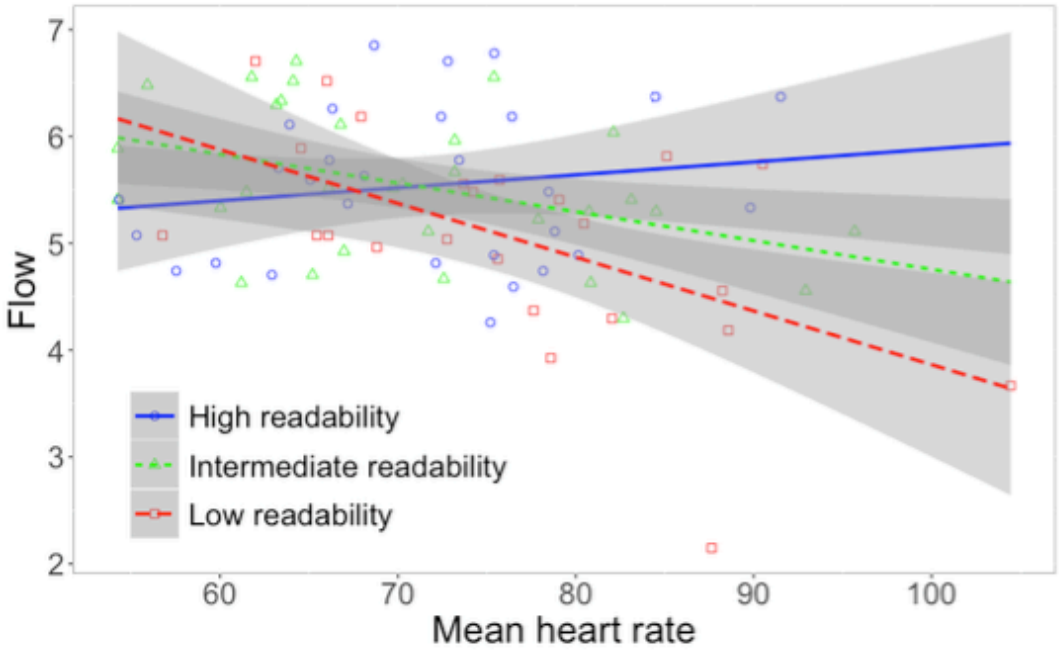


Figure 1. Associations between readers' self-reported flow experiences and mean heart rate (in bpm) during the reading phase in each experimental condition (high, intermediate, and low readability). Confidence intervals are represented by grey-shaded areas.

Figure 2. Flow and Root Mean Square of Successive Differences in Heart Rate Variability During Reading

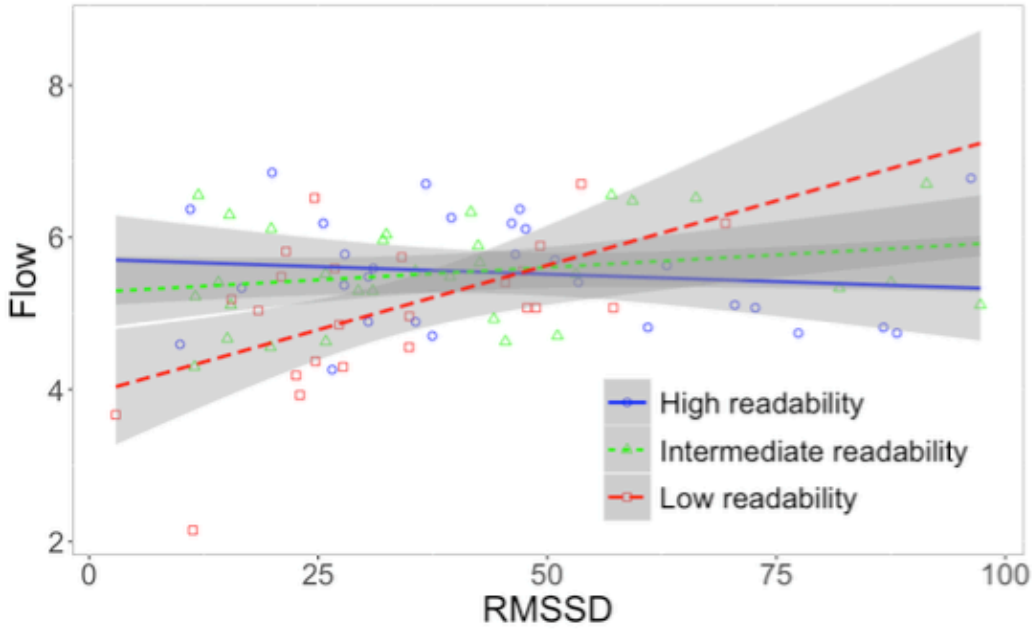


Figure 2. Associations between readers' self-reported flow experiences and RMSSD (in ms) extracted over the reading phase in each experimental condition (high, intermediate, and low readability). Confidence intervals are represented by grey-shaded areas.

Supplemental Material

Supplement to "At the Heart of Optimal Reading Experiences: Cardiovascular Activity During Flow in Fiction Reading."

Measures Employed in the Study

1. Demographic Data

Sex

(single item; response format: forced-choice; response options: female, male, *or* no answer, *subsequently combined into a binary measure as no respondent chose* no answer*)*

Which gender do you identify with?

Educational level

(single item; response format: forced-choice; response options: ranging from no degree *to* postdoctoral qualification, *subsequently combined into a binary measure with the categories* no graduate degree *or* graduate degree*)*

What is the highest school/college degree that you have obtained so far?

Age

(single item; response format: forced-choice; response options: ranging from 18 years *to* 99 years*)*

How old are you?

2. Reader Variables

Interest in reading the *Odyssey*

(single item; response format: binary, yes *or* no*)*

Would you like to read another chapter from the *Odyssey*?

Reading frequency

(single item; response format: 7-point Likert scale, ranging from (almost) daily *to* never*)*

How frequently do you normally read novels or narratives?

Reading affinity

(single-item; response format: 7-point Likert scale, ranging from not at all *to* very much*)*

How much do you like to read?

Reading self-efficacy

(Self-developed scale; response format: 7-point Likert scale, ranging from strongly agree *to* strongly disagree*)*

If a book interests me, I do not care whether it is hard to read.

If a book interests me, I read it even if it is a long story.

If I cannot directly relate to a story, I can rely on my ability to empathize and understand texts.

I finish most books that I start reading within a short time span.

3. Reader Traits

Boredom proneness

(*Struk, Carriere, Cheyne, & Danckert (2017), Short Boredom Proneness Scale (SBPS); response format: 7-point Likert scale, ranging from* not at all *to* very much)

The 8-item SBPS is a brief self-report measure for an individual's general propensity to experience boredom across activities. Developed on the basis of the widely used Boredom Proneness Scale (BPS), it has good reliability estimates (α = .88). Moreover, in contrast to previously developed short boredom scales, it has a theoretically apt unidimensional factor structure. Positive correlations with measures for related constructs, such as aggression, depression, and mind-wandering, represent further evidence for the SBPS's construct validity.

Aesthetic responsiveness

(*Schlotz, Wallot, Omigie, Masucci, Hoelzmann, & Vessel (2019), Aesthetic Responsiveness and Engagement Assessment (AREA); response format: 5-point Likert scale, ranging from* never *to* very often)

The 14-item AREA measures self-reported individual responsiveness to aesthetic experiences. The AREA comprises three subscales: Aesthetic Appreciation, Intense Aesthetic Experience, and Creative Engagement, as well as a total score comprising the three subscales. Positive correlations with self-reported aesthetic experiences and hedonic responses to art support the scale's

validity. Additionally, internal consistency scores between .72 and .90 demonstrate its reliability for German and U.S. validation samples.

4. Reader Skills (LGVT)

(Schneider, Schlagmüller, and Ennemoser (2017), Reading Speed and Comprehension Test (LGVT); response format: one correct and two false response options to choose from based on the textual context for each gap)

The LGVT consists of a cloze test in which participants should read and fill in as much as possible in 6 minutes. Participants are instructed to read as quickly and accurately as they can. In order to select the correct response from the three response options that are presented for each gap, participants need to understand the textual context and identify the best match. For example, one item refers to the height of giraffes and then presents a gap instead of stating the height up to which the trees have barely any leaves left when a group of hungry giraffes has passed. By combining the information given earlier in the text (the giraffes' normal height) and logically applying it to the gap—as the highest height from which the giraffes can pick leaves must be roughly equal to their own height—participants can find the correct response. Given that the LGVT is a speed test and the text is fairly long, most participants are not able to fill in all deletions in the given time. Based on the numbers of correct and missing responses, scores for reading speed, comprehension, and accuracy are calculated.

5. Demand Perception

Perception of excessive demands

(single item; response format: 7-point Likert scale, ranging from not at all *to* very much*)*

To what extent did you perceive the text demands to be excessively high during reading?

5

Perception of low demands

(single item; response format: 7-point Likert scale, ranging from not at all *to* very much*)*

To what extent did you perceive the text demands to be too low during reading?

6. Reading Flow

(Thissen, Menninghaus, & Schlotz (2019), Fiction Reading Flow Scale (FRFS); response format: 7-point Likert scale, ranging from not at all *to* very much; $\omega = .93$*)*

Images, ideas, and feelings came to my mind on their own while I was reading.

The story came to life in my mind while I was reading.

I felt immersed in the story while I was reading.

The reading put me in a pleasant state.

I liked reading the story.

I would have liked to continue reading the story.

I was completely absorbed in the reading.

While I was reading, I hardly took notice of what was going on around me.

My thoughts were riveted on the story.

I was completely oblivious while I was reading.

Things that normally occupy me disappeared from my thoughts while I was reading.

My own life took a back seat while I was reading.

I lost a sense of time while I was reading.

Time stood still for me while I was reading.

I find it difficult to say how long I was reading.

Reading this story went smoothly and fluently for me.

I would readily have continued reading for a long time.

For me, it was no hassle to read the story.

I felt optimally engrossed while I was reading.

It felt as if the story was written just for me to read.

The story suited me well as a reader.

I had an immediate connection to the story while I was reading.

I naturally slipped into the story while I was reading.

6

I was able to spontaneously get the gist of the story while I was reading.

While I was reading, I intuitively understood the story.

While I was reading, I knew what the point of the story was.

I had no problem following the story while I was reading.

Supplemental Data Analysis

1. Sample Characteristics

Table S1

Characteristics of the Study Sample

	Condition				
	High readability	Intermediate readability	Low readability	Test statistic	*p*
n	29	31	24		
Sex (female) [a]	15 (52%)	17 (55%)	16 (67%)	$\chi^2_2 = 1.82$	.770
Educational level (graduate degree) [a]	15 (52%)	13 (42%)	13 (54%)	$\chi^2_2 = 6.91$	.547
Interest in the *Odyssey* (high) [a]	25 (86%)	27 (87%)	22 (92%)	$\chi^2_2 = 0.42$	.811
Reading frequency [b]	6 (1.00)	6 (2.00)	6 (2.58)	$\chi^2_2 = 0.11$	.948
Reading affinity [b]	5 (1.00)	5 (0.83)	5 (0.58)	$\chi^2_2 = 0.55$	.762
Age (years) [c]	34.72 (14.62)	34.29 (15.55)	34.38 (16.96)	$F_{2,81} = 0.01$	.994
Reading self-efficacy [c]	5.38 (0.79)	5.59 (0.97)	5.53 (0.91)	$F_{2,81} = 0.43$	.651
Reading accuracy (LGVT) [c]	95.59 (3.51)	93.75 (6.13)	91.90 (7.04)	$F_{2,47} = 3.15$	.052
Reading comprehension (LGVT) [c d]	56.55 (19.50)	53.68 (15.71)	56.08 (16.73)	$F_{2,81} = 0.23$	.792
Reading speed (LGVT) [c]	29.66 (10.24)	28.74 (8.52)	30.46 (9.90)	$F_{2,81} = 0.23$	.793
Aesthetic responsiveness (AREA) [c]	3.09 (0.60)	2.94 (0.68)	3.03 (0.59)	$F_{2,81} = 0.45$	.635
Boredom proneness (SBPS) [c]	2.36 (0.82)	2.16 (0.82)	2.11 (0.86)	$F_{2,81} = 0.67$	.517

Note. LGVT = Reading Speed and Comprehension Test; AREA = Aesthetic Responsiveness and Engagement Scale; SBPS = Short Boredom Proneness Scale.

[a] *n* (relative frequency) and Chi^2 test statistic for binary measures. [b] Median (interquartile range) and Kruskal Wallis test statistic for rating scores. [c] Mean (standard deviation) and one-way analysis of variance test statistic for scale scores. [d] Test statistic using Welch's correction for variance heterogeneity. For all means and medians, higher values indicate more extreme responses in the direction of the construct assessed.

8

2. Readability Indices and Text Characteristics

Table S2

Readability Indices and Text Characteristics for the Different Text Versions Used as Reading Material

Measure	Condition		
	High readability	Intermediate readability	Low readability
Readability Indices			
Flesch-Kincaid Grade Level	4.10	8.13	11.59
ARI	4.90	9.96	13.93
Coleman-Liau index	7.98	11.86	11.60
Flesch Reading Ease	82.88	64.19	56.37
Gunning Fog index	5.45	9.18	13.10
LIX	23.87	38.75	45.82
SMOG index	6.38	8.91	10.65
RIX	1.37	3.60	5.21
Text Characteristics			
TTR	0.20	0.39	0.29
Words per sentence	9.68	15.4	24.9
Syllables per word	1.35	1.50	1.48
Long words	836.00	1,097.00	1,245.00
Complex words	235.00	355.00	466.00
Length of text in words	5,961.00	4,698.00	5,954.00

Note. ARI = Automated Readability Index; LIX = Lesbarkeitsindex [Readability Index]; SMOG = Simple Measure of Gobbledygook; RIX = Rate Index; TTR = Type–Token Ratio—the total number of unique words (types) divided by the total number of words (tokens). For Flesch Reading Ease, lower values indicate higher reading difficulty, i.e., lower readability of the text. For all other readability indices, higher values indicate higher reading difficulty, i.e., lower readability of the text. TTR indicates lexical diversity and / or lexical density, with a higher index meaning that the vocabulary is more diverse. Regarding the syllables per word, values around 1.50 are expected for standard language. For further information regarding the interpretation of the indices, please see Reck and Reck (2007).

3. Regression Analyses for Heart Rate Without Outliers

Table S3

Summary of Regression Analyses for Mean Heart Rate (in bpm) Predicting Readers' Flow Scores by Experimental Condition (High, Intermediate, and Low Readability) Without Outliers; Reference Group Is High Readability

	Model 1				Model 2			
	B	*SE*	β	*p*	*B*	*SE*	β	*p*
Intercept	5.550	0.13	.00	**< .001**	5.532	0.14	.00	**< .001**
Intermediate readability	-0.056	0.18	-.03	.754	0.009	0.19	.01	.964
Low readability	-0.235	0.20	-.14	.233	-0.228	0.22	-.14	.307
Reading HR	0.012	0.01	.17	.382				
Intermediate readability × reading HR	-0.039	0.02	-.36	**.033**				
Low readability × reading HR	-0.046	0.02	-.30	**.035**				
HR change					-0.005	0.04	-.03	.875
Intermediate readability × HR change					0.005	0.05	.01	.933
Low readability × HR change					-0.027	0.06	-.07	.654
R^2	.15				.04			

Note. HR = heart rate. HR was centered at the grand mean of each phase (72.6 bpm for reading values and 0.002 bpm for change scores). Model 1 uses the HR during reading as the cardiovascular predictor, while Model 2 uses the HR change score, i.e., participants' average baseline HR subtracted from their average HR during reading, as the cardiovascular predictor. Outliers were defined as data points that were more than 3 standard deviations from the mean, which yielded one outlier for flow scores and one outlier for HR.

4. Regression Analyses for the Root Mean Square of Successive Differences Without Outliers

Table S4

Summary of Regression Analyses for Root Mean Square of Successive Differences (in ms) Predicting Readers' Flow Scores by Experimental Condition (High, Intermediate, and Low Readability) Without Outliers; Reference Group Is High Readability

	Model 1				Model 2			
	B	*SE*	β	*p*	*B*	*SE*	β	*p*
Intercept	5.556	0.13	.00	**< .001**	5.538	0.14	.00	**< .001**
Intermediate readability	-0.017	0.18	-.01	.925	0.010	0.19	.01	.957
Low readability	-0.224	0.21	-.14	.280	-0.292	0.22	-.17	.183
Reading RMSSD	-0.004	0.01	-.12	.490				
Intermediate readability × reading RMSSD	0.011	0.01	.21	.176				
Low readability × reading RMSSD	0.029	0.01	.34	**.010**				
RMSSD change					0.005	0.01	.07	.728
Intermediate readability × RMSSD change					-0.000	0.02	-.00	.992
Low readability × RMSSD change					0.001	0.02	.06	.741
R^2	.15				.06			

Note. RMSSD = root mean square of successive differences. RMSSD was centered at the grand mean (39.9 ms for reading values and -2.5 ms for change scores). Model 1 uses the RMSSD during reading as the cardiovascular predictor, while Model 2 uses the RMSSD change score, i.e., participants' baseline RMSSD subtracted from their RMSSD during reading, as the cardiovascular predictor. Outliers were defined as data points that were more than 3 standard deviations from the mean, which yielded one outlier for flow scores.

5. Regression Analyses for Heart Rate Adjusted for Reading Accuracy

Table S5

Summary of Regression Analyses for LGVT Reading Accuracy and Mean Heart Rate (in bpm) Predicting Readers' Flow Scores by Experimental Condition (High, Intermediate, and Low Readability) Without Outliers; Reference Group Is High Readability

	Model 1				Model 2			
	B	*SE*	β	*p*	*B*	*SE*	β	*p*
Intercept	5.804	1.32	.00	**< .001**	6.288	1.44	.00	**< .001**
Intermediate readability	-0.061	0.18	-.04	.737	0.009	0.19	-.01	.965
Low readability	-0.247	0.21	-.15	.234	-0.253	0.23	-.16	.270
Reading HR	0.012	0.01	.17	.387				
LGVT reading accuracy	-0.003	0.01	-.02	.847				
Intermediate readability × reading HR	-0.039	0.02	-.36	**.035**	-0.008	0.02	-.07	.598
Low readability × reading HR	-0.045	0.02	-.30	**.039**				
HR change					-0.006	0.03	-.03	.860
Intermediate readability × HR change					0.001	0.06	.00	.984
Low readability × HR change					-0.031	0.06	-.08	.610
R^2	.15				.04			

Note. LGVT = reading speed and text comprehension test; HR = heart rate. HR was centered at the grand mean of each phase (72.6 bpm for reading values and 0.002 bpm for change scores). Model 1 uses the HR during reading as the cardiovascular predictor, while Model 2 uses the HR change score, i.e., participants' average baseline HR subtracted from their average HR during reading, as the cardiovascular predictor. Outliers were defined as data points that were more than 3 standard deviations from the mean, which yielded one outlier for flow scores and one outlier for HR.

6. Regression Analyses for Root Mean Square of Successive Differences Adjusted for Reading Accuracy

Table S6

Summary of Regression Analyses for LGVT Reading Accuracy and Root Mean Square of Successive Differences (in ms) Predicting Readers' Flow Scores by Experimental Condition (High, Intermediate, and Low Readability) Without Outliers; Reference Group Is High Readability

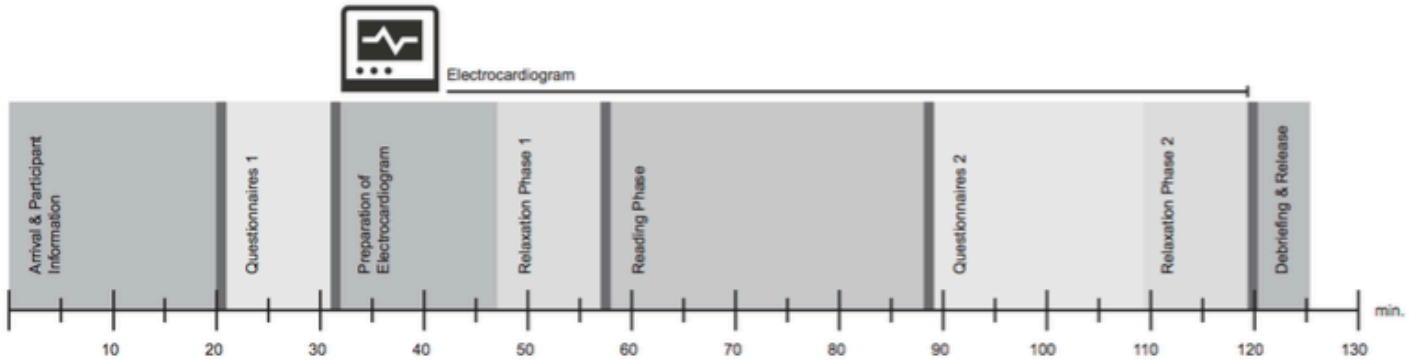
	Model 1				Model 2			
	B	*SE*	β	*p*	*B*	*SE*	β	*p*
Intercept								
Intermediate readability	6.135	1.35	.00	**< .001**	6.414	1.41	.00	**<.001**
Low readability	-0.027	0.19	-.01	.883	-0.006	0.20	-.00	.974
Reading RMSSD	-0.250	0.22	-.15	.250	-0.362	0.23	-.20	.151
LGVT reading accuracy	-0.004	0.01	-.11	.515				
Intermediate readability × reading RMSSD	-0.006	0.01	-.05	.668	-0.009	0.02	-.07	.535
Low readability × reading RMSSD	0.011	0.01	.21	.179				
RMSSD change	0.029	0.01	.34	**.012**				
Intermediate readability × RMSSD change					0.005	0.01	.07	.733
Low readability × RMSSD change					-0.000	0.02	-.00	.993
R^2					0.006	0.02	.07	.719
	.15				.07			

Note. LGVT = reading speed and text comprehension test; RMSSD = root mean square of successive differences. RMSSD was centered at the grand mean (39.9 ms for reading values and -2.5 ms for change scores). Model 1 uses the RMSSD during reading as the cardiovascular predictor, while Model 2 uses the RMSSD change score, i.e., participants' baseline RMSSD subtracted from their RMSSD during reading, as the cardiovascular predictor. Outliers were defined as data points that were more than 3 standard deviations from the mean, which yielded one outlier for flow scores.

Procedure

Figure S1

Graphical Depiction of the Experimental Procedure



Note. This figure demonstrates the experimental procedure each participant underwent. The axis shows an approximation of the duration of each experimental phase in minutes.

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Eidesstattliche Versicherung

Ich erkläre hiermit, dass ich die vorgelegte Dissertation mit dem Titel "Flow beim Lesen" selbstständig angefertigt und mich anderer Hilfsmittel als der in ihr angegebenen nicht bedient habe, insbesondere, dass alle Entlehnungen aus anderen Schriften mit Angabe der betreffenden Schrift gekennzeichnet sind.

Ich versichere, die Grundsätze der guten wissenschaftlichen Praxis beachtet und nicht die Hilfe einer kommerziellen Promotionsvermittlung in Anspruch genommen zu haben.

Frankfurt am Main, 21.01.2020

Birte Thissen (MSc Psychologie)

Erklärung

Ich erkläre hiermit, dass ich mich bisher keiner Doktorprüfung unterzogen habe.

Frankfurt am Main, 21.01.2020 _____

Birtc Thissen (MSc Psychologie)

Erklärung über die Erfüllung der Kriterien für publikationsbasierte Dissertationen

1. Die publikationsbasierte Dissertation soll in der Regel 3 Schriften umfassen, die aus den letzten 5 Jahren stammen sollen.

Die Dissertation umfasst 3 Schriften, die innerhalb der letzten 5 Jahre verfasst wurden. Schrift I wurde bereits in einem wissenschaftlichen Journal veröffentlicht. Schrift II wurde zur Begutachtung eingereicht und befindet sich in der zweiten Runde der Revision. Schrift III wurde ebenfalls zur Begutachtung eingereicht.

Schrift I:

Thissen, B. A. K., Menninghaus W., & Schlotz W. (2018). Measuring Optimal Reading Experiences: The Reading Flow Short Scale. *Frontiers in Psychology 9*, 1-12. doi: 10.3389/fpsyg.2018.02542

Schrift II:

Thissen, B. A. K., Menninghaus W., & Schlotz W. (2019). The Pleasures of Reading Fiction Explained by Flow, Presence, Identification, Suspense, and Cognitive Involvement [Revised manuscript submitted for publication].

Schrift III:

Thissen, B. A. K., Schlotz W., Abel, C., Scharinger, M., Merrill, J., Haider, T., & Menninghaus W. (2019). At the Heart of Optimal Reading Experiences – Cardiovascular Activity during Flow in Fiction Reading. [Manuscript submitted for publication].

2. Die Schriften sollen im Wesentlichen einem zusammenhängenden Forschungsprogramm entstammen. Die jeweils verfolgten Forschungsfragen sollen sich sinnvoll zueinander in Beziehung setzen lassen.

Die Schriften entstammen einem zusammenhängenden Forschungsprojekt zum Thema *Flow beim Lesen*. Die jeweils verfolgten Forschungsfragen stehen sinnvoll zueinander in Beziehung, da sie sich auf die psychometrische Erfassung von Flow beim Lesen, auf das Zusammenspiel von Flow mit anderen Erlebnis-

formen beim Lesen und auf psychophysiologische Korrelate von Flow beim Lesen beziehen .

3. Der Kandidat oder die Kandidatin soll bei 2 Publikationen Erstautor/Erstautorin sein, bei einer weiteren Publikation kann er/sie Koautor/Koautorin sein. Eine geteilte Erstautorenschaft wird für jeden der Erstautoren anteilig gewichtet (bei 2 Erstautoren eine 1/2 Erstautorenschaft, bei 3 eine 1/3 Erstautorenschaft usw.).

Ich habe die Erstautorenschaft bei allen Schriften (I-III) inne. Eine geteilte Erstautorenschaft liegt nicht vor.

4. Die drei Schriften sollen zur Veröffentlichung zumindest eingereicht sein. Der aktuelle Status ist detailliert darzulegen (Publikationsorgan und Status wie eingereicht, in revision, conditional accept usw.).

Schrift I ist bereits in *Frontiers in Psychology* veröffentlicht.
Schrift II befindet sich in revidierter Fassung zur Begutachtung bei *Psychology of Aesthetics, Creativity, and the Arts* (siehe Bestätigungsmail).
Schrift III befindet sich zur Begutachtung bei *Media Psychology* (siehe Bestätigungsmail).

5. Mindestens 2 der 3 Schriften müssen in guten oder sehr guten, in der Regel englischsprachigen, Zeitschriften mit Peer-Review eingereicht sein.

Die 3 Schriften sind in guten englischsprachigen Zeitschriften mit Peer-Review veröffentlicht bzw. eingereicht.

Schrift I: *Frontiers in Psychology:* Impact Factor 2.129
(liegt als Publikation vor)
Schrift II: *Psychology of Aesthetics, Creativity, and the Arts:*
Impact Factor 2.325
(ist zur Begutachtung eingereicht und in revision)
Schrift III: *Media Psychology:* Impact Factor 2.736
(ist zur Begutachtung eingereicht)

6. Eine der 3 Schriften kann als Publikation in einem einschlägigen Lehrbuch, Enzyklopädieband oder einem anderen für das jeweilige Fach bedeutsamen Publikationsorgan, jeweils mit Peer-Review, eingereicht oder veröffentlicht sein.

Keine der 3 Schriften ist als Publikation in einem einschlägigen Lehrbuch, Enzyklopädieband oder einem anderen für das Fach Psychologie bedeutsamen Publikationsorgan, jeweils mit Peer-Review, eingereicht oder veröffentlicht.

7. Die als Dissertation vorgelegte Abhandlung soll über die zusammengestellten Publikationen hinaus einen zusätzlichen Text enthalten, in welchem eine kritische Einordnung der eigenen Publikationen aus einer übergeordneten Perspektive heraus vorgenommen wird. Dieser Text sollte einen Umfang von ca. 30 Seiten haben. Es sollen die Fragestellungen theoretisch entwickelt werden, die empirischen Arbeiten und ihre Ergebnisse so dargestellt werden, dass sie auch ohne Lesen der Einzelarbeiten nachvollziehbar sind, und es soll eine Gesamtdiskussion enthalten sein, die die Fragestellungen beantwortet und den Erkenntnisgewinn der Arbeit herausstellt.

Die vorgelegte Abhandlung beinhaltet eine Herleitung der grundlegenden Fragestellungen, eine ausführliche zusammenfassende Darstellung der 3 Schriften und eine übergreifende Diskussion mit kritischer Würdigung der 3 Studien sowie der hierauf basierenden weiteren Forschungsperspektiven.

Frankfurt am Main, 21.01.2020 

Birte Thissen (MSc Psychologie)

Erklärung über die Eigenleistung der publikationsbasierten Dissertation

Für das Forschungsprojekt *Flow beim Lesen* wurden drei Studien durchgeführt. Ich war wesentlich an der Entwicklung der übergeordneten Fragestellung und des Studiendesigns, der Datenerhebung, der Auswertung der Daten und der Diskussion der Ergebnisse beteiligt. Dementsprechend stelle ich im Folgenden meine Eigenleistungen an den einzelnen Schriften dar.

Schrift I:

Thissen, B. A. K., Menninghaus W., & Schlotz W. (2018). Measuring Optimal Reading Experiences: The Reading Flow Short Scale. *Frontiers in Psychology 9*, 1-12. doi: 10.3389/fpsyg.2018.02542

Eigener Anteil: Die Fragestellung und das Studiendesign wurden von mir unter Mitwirkung von Wolff Schlotz und Winfried Menninghaus entwickelt. Die Rekrutierung von Studienteilnehmern und die Datenerhebung wurden von mir unter Mithilfe einer wissenschaftlichen Hilfskraft durchgeführt. Alle Daten wurden von mir ausgewertet, wobei ich durch Wolff Schlotz wissenschaftlich betreut wurde. Das Manuskript wurde durch mich verfasst und von beiden Co-Autoren inhaltlich und sprachlich überarbeitet.

Schrift II:

Thissen, B. A. K., Menninghaus W., & Schlotz W. (2019). The Pleasures of Reading Fiction Explained by Flow, Presence, Identification, Suspense, and Cognitive Involvement [Revised manuscript submitted for publication].

Eigener Anteil: Fragestellung und Studiendesign und somit auch das in der Studie getestete Messinstrument und Modell für Flow beim Lesen wurden von mir unter Mitwirkung von Wolff Schlotz und Winfried Menninghaus entwickelt. Die Datenerhebung und die Rekrutierung der Studienteilnehmer wurden von mir zusammen mit einer wissenschaftlichen Hilfskraft durchgeführt. Die Datenauswertung erfolgte durch mich und wurde von Wolff Schlotz wissenschaftlich betreut. Das Manuskript wurde durch mich verfasst, wobei beide Co-Autoren inhaltliche und sprachliche Überarbeitungen beisteuerten.

Schrift III:

Thissen, B. A. K., Schlotz W., Abel, C., Scharinger, M., Merrill, J., Haider, T., & Menninghaus W. (2019). At the Heart of Optimal Reading Experiences – Cardiovascular Activity during Flow in Fiction Reading. [Manuscript submitted for publication].

Eigener Anteil: Die Entwicklung der Fragestellung und des Studiendesigns erfolgte durch mich unter Mitwirkung von Wolff Schlotz, Winfried Menninghaus und Cornelius Abel. Die Rekrutierung der Studienteilnehmer und die Datenerhebung wurden von mir mit Unterstützung zweier wissenschaftlicher Hilfskräfte durchgeführt. Die Daten wurden von mir ausgewertet, wobei Cornelius Abel, Mathias Scharinger und Julia Merrill bei der Vorverarbeitung der psychophysiologischen Daten mitwirkten und Wolff Schlotz die statistische Datenanalyse wissenschaftlich betreute. Die Analyse der Text-Stimuli im Hinblick auf Readability-Indizes wurde von Thomas Haider vorgenommen. Das Manuskript wurde durch mich verfasst und einer inhaltlichen und sprachlichen Überarbeitung durch alle Autoren unterzogen.

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Thissen, B. A. K., Schlotz W., Abel, C., Scharinger, M., Merrill, J., Haider, T., & Menninghaus W. (2020). At the Heart of Optimal Reading Experiences - Cardiovascular Activity during Flow in Fiction Reading. [Manuscript submitted for publication].

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Konferenzteilnahmen

6/2019 Flow-Symposium, Max-Planck-Institut für empirische Ästhetik, Frankfurt am Main (Deutschland)
Gesamtorganisation des Symposiums
Vortrag: *Optimal Reading Experiences: Flow and its Psychophysiological Indicators in Fiction Readers* (Birte Thissen, Winfried Menninghaus, Mathias Scharinger, & Wolff Schlotz)

9/2018 25th Biennial Congress of the International Association of Empirical Aesthetics (IAEA), Toronto (Kanada)
Vortrag: *Capturing Optimal Reading Experiences – Flow States in Fiction Reading* (Birte Thissen, Wolff Schlotz, Moniek Kuijpers, & Winfried Menninghaus)

7/2018 51. Kongress der Deutschen Gesellschaft für Psychologie (DGPS), Frankfurt (Deutschland)
Vortrag: *Capturing Optimal Media Experiences: Flow in Fiction Reading* (Birte Thissen, Wolff Schlotz, Moniek Kuijpers, & Winfried Menninghaus)

7/2018 16th Biennial Conference of the International Society of Empirical Study of Literature (IGEL), Stavanger (Norwegen)
Vortrag: *Capturing Optimal Reading Experiences: Flow and Presence in Fiction Reading* (Birte Thissen, Moniek Kuijpers, Winfried Menninghaus, & Wolff Schlotz)

6/2018 9th European Conference on Positive Psychology (ECPP), Budapest (Ungarn)
Vortrag: *Measuring Optimal Reading Experiences: Flow in Fiction Reading* (Birte Thissen, Winfried Menninghaus, & Wolff Schlotz)

5/2018 3. Konferenz der Deutschen Gesellschaft für Positive Psychologie (DGPPF), Bochum (Deutschland)
Vortrag: *Capturing Optimal Reading Experiences: Flow in Fiction Reading* (Birte Thissen, Winfried Menninghaus, Moniek Kuijpers, & Wolff Schlotz)

3/2017 59. Tagung experimentell arbeitender Psychologen (TEAP), Dresden (Deutschland)
Vortrag: *Flow Experiences during Fiction Reading* (Birte Thissen, Wolff Schlotz, Moniek Kuijpers, & Winfried Menninghaus)

7/2016 15th Biennial Conference of the International Society of Empirical Study of Literature (IGEL), Chicago (USA)
Posterpräsentation: *The Potential Role of Flow Experiences in Reading* (Birte Thissen)

Frankfurt am Main, 21.01.2020 

Birte Thissen (MSc Psychologie)

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